No. 8. Vol. 5.
(New Series. No. 4. Vol. I.)

SIXPENCE.
(Registered as a Newspaper)

Friday,
November 4, 1904.

PAGE'S WEEKLY

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UNIVERSITY OF TORONTO

ENGINEERING · ELECTRICITY SHIPBUILDING MINING IRON & STEEL INDUSTRIES

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WHICH YOU CAN **RELY** *ON IS* "*Klingerit*"

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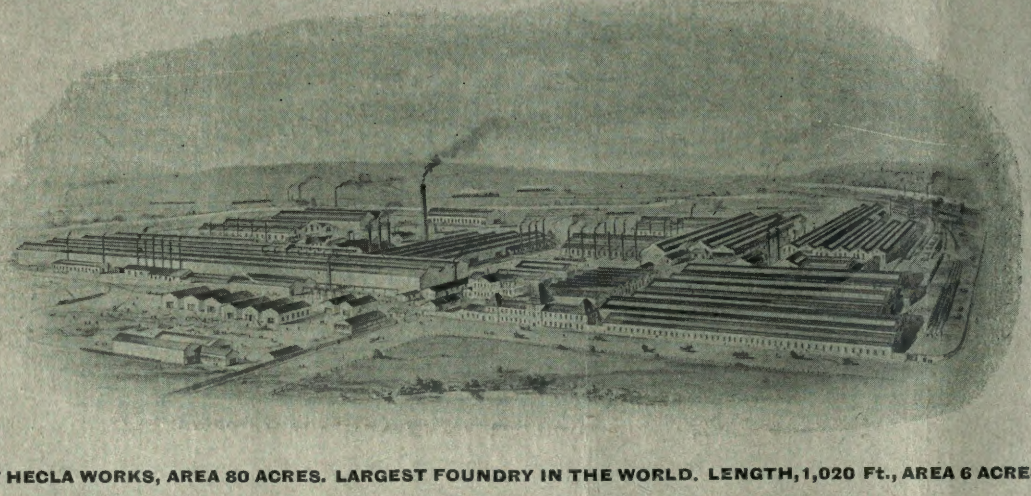
HADFIELD'S STEEL FOUNDRY Co., LTD., SHEFFIELD.



EAST HECLA WORKS, AREA 80 ACRES. LARGEST FOUNDRY IN THE WORLD. LENGTH, 1,020 Ft., AREA 6 ACRES.

HADFIELD'S PATENT "ERA" MANGANESE STEEL

IS THE SUPREME MATERIAL FOR

TRAMWAY POINTS AND CROSSINGS AND CRUSHER WEARING PARTS.

PAGE'S WEEKLY Miscellaneous

Mr. G. H. HUGHES, M.I.Mech.E.,

Consulting and Organising Engineer for Water Works and Industrial Undertakings,

97, QUEEN VICTORIA ST., LONDON, E.C.

Telephone No.: 5754 Bank. Write for particulars.

PAGE & ROWLINGSON,

Chartered Patent Agents.

Mr. PAGE, who is a Whitworth Exhibitioner and an Associate Member of the Institute of Civil Engineers, has had a large experience as a Practical Mechanical Engineer, and is specially qualified to deal with the most intricate mechanical problems successfully. *Write for Handbook of Information Free.*

28, NEW BRIDGE STREET, LONDON, E.C.,
And 14, St. Ann's Square, Manchester.

GRAHAM, MORTON & Co. LTD.,

Head Office and Works, **LEEDS.**

Makers and Erectors of all Classes of
CONVEYING PLANTS, COAL HANDLING PLANTS, AERIAL ROPEWAYS, &c., &c.

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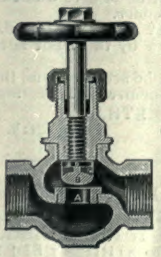
WALTER SCOTT, LTD., LEEDS STEEL WORKS, LEEDS, ENGLAND.

MANUFACTURERS OF . . .
Rolled Steel Joists, Channels, etc.
Mild Steel Blooms, Billets, Slabs, Tinbars, Rounds and Flats.
Speciality: TRAMRAILS.

The "SHAW" Patent Steam Valves . .



With Renewable Seats, Interchangeable Concentric Valve, Compound Packing to Spindle, Special Metal, and High-Class Workmanship.

The "SHAW" Patent Parallel Slide Valve is the Acme of Simplicity and Durability.

Try Them ! Sent on Approval.

☞ *Write for particulars of these and other Specialities for High Pressure Steam.*

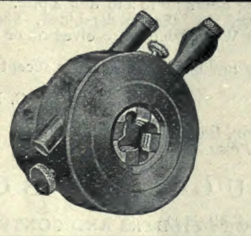
JOSEPH SHAW, B Dept., Albert Works, HUDDERSFIELD.

JOHN HARDISTY, M.I.C.E., M.I.M.E.,

10, INDEPENDENT BUILDINGS,
FARGATE, SHEFFIELD.

MACHINERY VALUER.

Telegrams: "HARDENED, SHEFFIELD." *Telephone* 3786.



HARTNESS

AUTOMATIC OPENING DIE

The most satisfactory means yet devised for the production of screw threads.

JONES & LAMSON MACHINE CO.,
JUBILEE BUILDINGS,
97, Queen Victoria Street, LONDON.

ED. BRAND, *MECHANICAL ENGINEER,* 35, SHAKESPEARE STREET, MANCHESTER.

Modern Wire-Working Machinery,
Such as for Rolling, Drawing, Weaving, Netting, Forming, Automatic Straightening and Cutting, Cabling, Testing, &c.

Inquiries Solicited. Teleg. Address: "Filieres, Manchester."

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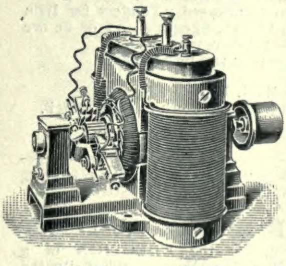


ALTERNATORS, TRANSFORMERS, &c.

Catalogue on Application.

THE CRYPTO ELECTRICAL CO.,
3, Tyers Gateway,
Bermondsey St.,
LONDON, S.E.

Telegrams:—
"COMMUTATOR, LONDON."

ENGINEERING PHOTOGRAPHY

Price List on application to— BOOKER & SULLIVAN,
67 and 69, Chancery Lane, Telephone: 9252 Central, LONDON, W.C.

PAGE'S WEEKLY Contracts

CONTRACTS.

GREAT WESTERN RAILWAY.

The DIRECTORS of this Company are prepared to receive TENDERS for the SUPPLY of about 470 tons of STEEL GIRDERS and other Iron and Steel Work of British manufacture.

Plans and Specification may be seen and Forms of Tender and Bills of Quantities obtained at the Office of the Engineer at this Station, between the hours of 10 a.m. and 4 p.m.

Tenders addressed to the undersigned, and marked outside "Tender for Girder Work," will be received on or before TUESDAY the 8th November.

The Directors do not bind themselves to accept the lowest or any Tender.

G. K. MILLS,
Secretary.

Paddington Station, London,
October 20th, 1904.

BOROUGH OF BOOTLE.

TO BRIDGE BUILDERS AND CONTRACTORS.

The CORPORATION of Bootle invite TENDERS for the CONSTRUCTION and ERECTION of a STEEL GIRDER BRIDGE, including FOUNDATIONS and ABUTMENT WALLS, over the Leeds and Liverpool Canal in Linacre Lane.

Plans, Sections, and Specifications may be seen and Quantities obtained at the Office of Mr. B. J. Wolfenden, A.M.I.C.E., Borough Engineer, on payment of Two Guineas, which will be returned on receipt of a *bonâ fide* Tender.

Tenders (sealed and endorsed "Tender for Bridge") to be addressed to the Highways Committee, and delivered at the Town Clerk's Office not later than 10 a.m. on TUESDAY, 15th November, 1904.

The lowest or any Tender will not necessarily be accepted.

The person whose Tender may be accepted will be required to enter into a contract containing clauses as to the payment of the standard rate of wages and the observance of the recognised hours of labour in the trades engaged in carrying out the Contract.

By order,
J. HENRY FARMER,
Town Clerk.

October 20th, 1904.

SKEGNESS URBAN DISTRICT COUNCIL.

CAST-IRON PIPES.

The above-named Council invite TENDERS from responsible Ironfounders for the SUPPLY and FREE DELIVERY at Skegness of CAST-IRON PIPES, SPECIAL CASTINGS, &c., as Pressure Mains in connection with the Sewerage Works.

The Contract will comprise about 166 tons of 15in. Pipes, 41 tons of 6in. Pipes, and 26 tons of 3in. Pipes.

Full particulars, with Specification and Bills of Quantities, may be obtained from the Engineers, Messrs. Elliott and Brown, Burton Buildings, Parliament Street, Nottingham, after the 2nd November, 1904, on deposit of Two Guineas, which sum will be returned on receipt of a *bonâ fide* Tender not afterwards withdrawn.

Sealed Tenders, addressed to me, and endorsed "Tenders for Iron Pipes," to be delivered at the Council Offices, Skegness, on or before the first post on FRIDAY, the 11th November, 1904.

The lowest or any Tender will not necessarily be accepted.

By order,
GILBERT J. DASHPER,
Solicitor and Clerk to the Council.

Council Offices, Skegness,
October 19th, 1904.

TIMBER PILED WHARF, ON THE RIVER GARNOCK, NEAR IRVINE, FOR NOBEL'S EXPLOSIVES CO., LTD., GLASGOW.

TENDERS WILL BE RECEIVED AT

Ardeer Factory, Stevenston, for the ERECTION of a TIMBER PILED WHARF on the River Garnock, at a point situated about 500 yards from the Irvine Harbour, and for the DREDGER WORK in connection with same.

Tenders will be considered either separately or conjointly for the erection of the Wharf and for the Dredger Work.

Specifications may be obtained and Drawings seen on application to the Works Manager at Ardeer Factory, Stevenston, on payment of the sum of One Guinea, which will be returned on receipt of a *bonâ fide* Tender.

Tenders, the lowest or any of which the Company does not bind themselves to accept, must be handed in not later than FRIDAY, the 11th November, 1904.

NOBEL'S EXPLOSIVES CO., LTD.

Ardeer Factory, Stevenston,
October 12th, 1904.

WHITBY URBAN DISTRICT COUNCIL.

ELECTRICITY DEPARTMENT.

STEAM DYNAMO AND BOILER, &c.

The Council are prepared to receive TENDERS for the Supply and Erection of the following:—

1. ONE 200kw. DIRECT-CURRENT DYNAMO, coupled to a high-speed Engine, reciprocating or turbine type.
2. ONE WATER-TUBE BOILER, fitted with a Chain Grate Mechanical Stoker.

The Specification, with General Conditions and Form of Tender, can be obtained on application to L. H. King, Engineer, Council Offices, Whitby, Yorks.

Tenderers will have to take all measurements, &c., from the plans deposited at the Engineer's Office, Council Offices, Whitby; no plan of either section will be sent out.

Tenders to be endorsed and to reach the Engineer not later than 5 p.m. on MONDAY, 21st November, 1904.

The Council do not bind themselves to accept the lowest or any Tender.

W. SEATON GRAY, Clerk.

Council Offices, Whitby, Yorks, October 17th, 1904.

EAST INDIAN RAILWAY.

The East Indian Railway Company is prepared to receive

TENDERS FOR THE SUPPLY AND DELIVERY of:—

(1) BEATER PICKS, PHOWRAHS and SHOVELS,
(2) CANVAS, BUNTING, &c.,
(3) FIREBRICKS and FIRECLAY,
(4) WOOD SCREWS, NAILS, &c.,

as per Specifications to be seen at the Company's Offices.

Tenders are to be sent to the undersigned, marked "Tender for Beater Picks, &c.," or as the case may be, not later than Twelve o'clock Noon on WEDNESDAY, the 9th day of November proximo.

The Company reserves to itself the right to divide the order, also to decline any Tender without assigning a reason, and does not bind itself to accept the lowest or any Tender.

For each Specification a fee of £1 1s. is charged, which cannot under any circumstances be returned.

By order,
C. W. YOUNG,
Secretary.

Nicholas Lane, London, E.C.,
October 27th, 1904.

JOHANNESBURG MUNICIPALITY.

The Municipal Council of Johannesburg is prepared to receive

TENDERS FOR TWO 35 ton ELECTRIC OVERHEAD TRAVELLING CRANES

to Specification No. 9 of their Consulting Engineers, Messrs. MORDEY AND DAWBARN, 82, Victoria Street, London, S.W.

Copies may be seen on and after Saturday, November 5th, at the Council Offices, Johannesburg and at the Consulting Engineers' Offices in London, and may be obtained on payment of Five Guineas, which will be returned on receipt of a *bona fide* Tender.

Tenders must be addressed to Messrs. MORDEY AND DAWBARN, 82, Victoria Street, Westminster, S.W., and received by them not later than TUESDAY, December 27th, 1904.

The lowest or any Tender will not necessarily be accepted, and the Council will not be responsible for any expenses incurred in Tendering.

R. FEETHAM,
Town Clerk.

Johannesburg.

DUNDEE TOWN COUNCIL.—

ELECTRICITY DEPARTMENT.

The Town Council of Dundee are prepared to receive TENDERS for the RE-LAYING of the present COPPER STRIP FEEDER MAINS throughout the town with INSULATED CABLES.

Specifications, Drawings, and Forms of Tender may be had on application to the undersigned on deposit of Forty Shillings, which will be returned only on receipt of a *bona fide* Tender, accompanied by the specification and the accompanying drawings.

Tenders to be lodged with W. H. Blyth Martin, Esq., Clerk to the Council, City Chambers, Dundee, not later than first post, SATURDAY, November 12th, 1904, marked on the outside, "Tenders for Re-laying of Feeder Mains."

The Council do not bind themselves to accept the lowest or any offer.

H. RICHARDSON, A.M.I.E.E.,
City Electrical and Tramways Engineer.

Dudhope Crescent Road, Dundee,
October 25th, 1904.

PAGE'S WEEKLY Contracts

JOHANNESBURG MUNICIPALITY.

The Municipal Council of Johannesburg is prepared to receive

TENDERS FOR :—

TRANSFORMER PILLARS and SWITCHGEAR to Specification No. 8, of their Consulting Engineers, Messrs. MORDEY AND DAWBARN, 82, Victoria Street, London, S.W.

Copies may be seen on and after Saturday, November 5th, at the Council Offices, Johannesburg, and at the Consulting Engineers' Offices in London, and may be obtained on payment of Five Guineas, which will be returned on receipt of a *bonâ fide* Tender.

Tenders must be addressed to Messrs. MORDEY & DAWBARN, 82, Victoria Street, Westminster, S.W., and received by them not later than TUESDAY, December 27th, 1904.

The lowest or any Tender will not necessarily be accepted, and the Council will not be responsible for any expenses incurred in Tendering.

R. FEETHAM,
Johannesburg. Town Clerk.

SOUTH AUSTRALIAN GOVERNMENT RAILWAYS.

The AGENT-GENERAL for SOUTH AUSTRALIA is prepared to receive

TENDERS FOR THE SUPPLY AND DELIVERY of :—

One STEAM MOTOR and BOGIE for STEAM Motor Carriage, or Alternative Tenders for—

One COMPLETE MOTOR COACH, either Steam or other Motive Power.

Specification, Form of Tender, and Drawings may be seen at the undermentioned Office, and copies may be obtained at a cost of One Guinea. This amount will be repaid to unsuccessful Tenderers who have sent in *bona fide* Tenders, upon return of the documents in good condition, within one week of notice of non-acceptance of Tender.

Tenders are to be sent to the undersigned, marked "Tender for Steam Motor and Bogie, etc.," not later than One o'clock p.m., on MONDAY, November 28th, 1904.

The Agent-General does not bind himself to accept the lowest or any Tender.

H. ALLERDALE GRAINGER,
Agent-General for South Australia.
Threadneedle House, Bishopsgate Street Within, London, E.C.,
October 28th, 1904.

TO CIVIL ENGINEERS.

COMPETITION FOR DRAINAGE SCHEME for ROSS (HEREFORDSHIRE) URBAN DISTRICT COUNCIL.

The Council desire to provide for the DRAINAGE and DISPOSAL of the SEWAGE of the present Urban District, together with the area proposed to be added, and for that purpose INVITE COMPETITIVE SCHEMES.

Competitors to supply Plans, Sections, Specification, detailed Report and Estimate of the probable cost, which are to be delivered at the Offices of the undersigned not later than December 5th, 1904.

Premiums of £50, £25, and £10 will be paid by the Council for the Schemes which they may adjudge to be best in order of merit, and such Plans and Particulars to become the absolute property of the Council.

In the event of either Scheme being carried out, the premium will merge in the fees paid to the Engineer.

It is suggested that Competitors should in the preparation of their Schemes, have due regard to the initial cost of the Works, as well as the annual cost of maintaining and working the system.

The Council do not pledge themselves to carry out any of the proposed Schemes, but in the event of any Scheme being selected, it will be conditionally that the same be approved by the Local Government Board, and that the cost does not materially exceed the estimate submitted.

The Plans and Particulars to bear a distinctive motto, and a sealed envelope bearing the same motto and containing the name and address of the Competitor, to accompany the papers.

Any further information can be obtained upon application to the Town Surveyor, and

ERNEST R. DAVIES, Clerk.
Albion Chambers, Ross,
October 21st, 1904.

UNIVERSITY OF THE CAPE OF GOOD HOPE.

Builders desirous of TENDERING for the ERECTION of the ABOVE BUILDING in Queen Victoria Street, Cape Town, South Africa, are requested to communicate with the Architects, MESSRS. W. HAWKE, A.R.I.B.A., and W. N. McKINLAY, 35, Craven Street, Strand, London, W.C.

October 19th, 1904.

TO RAILWAY CONTRACTORS.

CARDIFF RAILWAY—CONTRACT No. 2.

The CARDIFF RAILWAY COMPANY invite

TENDERS FOR THE CONSTRUCTION

of 5⅝ miles of RAILWAY from the termination of the Railway (as recently constructed) at Tongwynlais to Treforest, in the County of Glamorgan.

The Plans, Sections, and Drawings may be seen, and the Specification, Schedule of Quantities, and Form of Tender and any further information obtained, at the Office of the Company's Engineers (Sir DOUGLAS FOX and Mr. ROBERT WHITE), Royal Chambers, Park Place, Cardiff, from Monday, October 31st, to November 4th, between the hours of 10 a.m. and 4 p.m.

Tenders addressed to the Secretary of the Company, will be received at 22A, Queen Anne's Gate, London, S.W., on or before THURSDAY, November 17th, 1904.

By order.
HENRY A. ROBERTS,
Secretary.

COUNTY BOROUGH OF PRESTON.— WATERWORKS EXTENSION.

CONTRACT No. 1.

The Corporation of Preston are prepared to receive TENDERS for the SUPPLY and DELIVERY at Longridge Railway Station, L. and N. W. Railway, near Preston, of about 2,000 TONS of CAST-IRON PIPES, chiefly 18in. internal diameter, together with special castings in connection therewith.

Specification, Drawing, Schedule of Quantities, Form of Tender, and all other information may be obtained on application to Mr. Thomas Cookson, A.M.Inst.C.E., Town Hall, Preston, on payment of Two Guineas, which will be returned to all persons making a *bona fide* Tender, after the Town Council have come to a decision on the Tenders, and the return of all documents entrusted to them.

Sealed Tenders, endorsed "Tender for Iron Pipes, etc.," must be delivered to the undersigned not later than 12 o'clock at noon on SATURDAY, November 12th next,

Contractors will be required at all times during the existence of their several contracts to pay the trades union rate of wages, and observe such hours of labour as are agreed to by the Employers' Associations and Trades Unions in the Borough of Preston, or the district in which the work is being carried out.

No pledge is given that the lowest or any Tender will be accepted.

HENRY HAMER,
Town Clerk.
Town Hall, Preston,
October 26th, 1904.

APPOINTMENTS OPEN.

EGYPTIAN GOVERNMENT.

PUBLIC WORKS DEPARTMENT.

APPLICATIONS ARE INVITED FOR THE

POST of INSPECTOR of IRRIGATION in the above service, for a period of five years, at an annual salary of One Thousand Egyptian Pounds, and a gratuity of one year's salary at the end of this period.

Applicants must be of English birth, and their age must not exceed 45 years. They must have had at least 15 years' service in the Irrigation Branch of the Indian Public Works Department.

Applications, which should contain a full statement of services, with certificates or references, should be addressed to—

THE UNDER SECRETARY OF STATE.
Public Works Department, Cairo, Egypt.

BATTERSEA BOROUGH COUNCIL.

TO ELECTRICAL ENGINEERS.

The Council invite

APPLICATIONS FOR THE APPOINTMENT

of ELECTRICAL ENGINEER to take entire charge of the Electric Supply Department and the running of the Station. Applicants must have had experience in the working of a three-wire continuous-current system. Commencing salary £400 per annum.

Forms of Application and Particulars of Duties may be obtained at the Town Hall, Lavender Hill, S.W., and must be delivered to me, duly filled up, and accompanied by copies of not more than four recent testimonials, under cover, endorsed "Electrical Engineer," by Mid-day, TUESDAY, November 15th. The person appointed will be required to reside within the Borough.

Personal canvassing strictly prohibited.

W. MARCUS WILKINS,
October 27th, 1904. Town Clerk.

BUYERS' DIRECTORY.

NOTE.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index to Advertisers on pages 23 and 25.*

In order to assure fair treatment to advertisers, each firm is indexed under its leading speciality ONLY.

Advertisers who prefer, however, to be entered under two or more different sections can do so by an annual payment of 5s. for each additional section.

Artesian Well Machinery.
John Z. Thom, Patricroft, Manchester.

Belting.
Binney & Son, Catherine Street. City Road, London, E.C.
Fleming, Birkby & Goodall, Ltd., West Grove, Halifax.
Rossendale Belting Co., Ltd.. 10, West Mosley Street, Manchester.

Boilers.
Clayton, Son & Co., Ltd., Leeds City Boiler Works, Leeds.
Grantham Crank & Iron Co., Ltd., Grantham.
John Thompson, Wolverhampton.

Boilers (Water-tube).
Babcock & Wilcox, Ltd., Oriel House, Farringdon Street, London, E.C.
Cochran & Co. (Annan), Ltd., Annan, Scotland.

Bolts, Nuts, Rivets, etc.
Herbert W. Periam, Ltd., Floodgate Street Works, Birmingham.
T. D. Robinson & Co., Ltd., Derby.

Books.
E. & F. N. Spon, 125, Strand, London, W.C.

Cables.
St. Helen's Cable Co., Ltd., Warrington, Lancashire.

Case-Hardening Compounds.
Hy. Miller & Co.. Millgarth Works, Leeds.

Chucks.
Fairbanks Co., 78-80, City Road, London, E.C.

Clutches (Friction).
David Bridge & Co., Castleton Ironworks, Rochdale, Lancashire.
H. J. H. King & Co., Nailsworth, Gloucestershire.

Condensing Plant.
Concentric Condenser, Ltd., 23, Northumberland Avenue, London, W.C.
Mirrlees-Watson & Co., Ltd., Glasgow.

Consulting Engineers.
G. H. Hughes, A.M.I.M.E., 97, Queen Victoria Street, London, E.C.

Continental Railway Arrangements.
South Eastern & Chatham Railway Co.

Conveying and Elevating Machinery.
Adolf Bleichert & Co., Leipzig-Gohlis, Germany.
Brown Hoisting Machinery Co.. 39, Victoria Street, London, S.W.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Graham, Morton & Co., Ltd.. Leeds.
Temperley Transporter Co., 72, Bishopsgate Street Within, London, E.C.

Coverings (Boiler)
Magnesia Coverings, Ltd., Washington Station, co. Durham.

Cranes, Travellers, Winches, etc.
Joseph Booth & Bros. Ltd, Rodley, Leeds.
Thomas Broadbent & Sons, Ltd., Huddersfield.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Cranks.
Clarke's Crank & Forge Co., Ltd., Lincoln, England.

Cutters (Milling).
E. G. Wrigley & Co., Ltd., Foundry Lane Works, Soho, Birmingham.

Destructors.
Horsfall Destructor Co., Ltd., Armley, Leeds.

Dredges and Excavators.
Delange & Cie, Mce., Hoboken, near Antwerp.
Lobnitz & Co., Ltd., Renfrew.
Rose, Downs & Thompson, Ltd., Old Foundry, Hull.

Economisers.
E. Green & Son, Ltd., Manchester.

Ejectors (Pneumatic).
Hughes & Lancaster, 47, Victoria Street, London, S.W.

Electrical Apparatus.
Allgemeine Elektricitäts Gesellschaft, Berlin, Germany.
Broadbent, T. W., Victoria Electrical Works, Huddersfield.
Bruce Peebles & Co., Ltd., Edinburgh.
Brush Electrical Engineering Co., Ltd., Victoria Works Belvedere Road, London, S.E.
Crompton & Co., Ltd., Arc Works, Chelmsford.
Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey Street, London, S.E.
Gent & Co., Ltd., Faraday Works, Leicester.
Greenwood & Batley, Ltd.. Albion Works, Leeds.
India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., The, Silvertown, London, E.
Mather & Platt, Ltd.. Salford Iron Works, Manchester.
Matthews & Yates, Ltd., Swinton, Manchester.
Mix and Genest, Berlin, W., Germany.
Nalder Bros. & Thompson, 34. Queen Street, London, E.C.
Newton Brothers, Full Street, Derby.
Phœnix Dynamo Manufacturing Co., Bradford, Yorks.
Premier Electrolyte Co., 26, Spital Square, London, E.
Simplex Steel Conduit Co., Ltd., 20, Bucklersbury, London, E.C.
Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street London, E.C.
Turner, Atherton & Co., Ltd., Denton, Manchester.
B. Weaver & Co., 22, Rosoman Street, Clerkenwell, London, E.C.

Engines (Electric Lighting).
J. & H. McLaren, Midland Engine Works Leeds.

Engines (Locomotive).
Baldwin Locomotive Works, Philadelphia, Pa., U.S.A.
Hunslet Engine Co., Ltd., Leeds, England.
Hudswell, Clarke & Co., Ltd., Leeds, England.

Engines (Stationary).
Allis-Chalmers Co., 533, Salisbury House, Finsbury Circus, London, E.C.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Momentum Engine, 19, 19a, Imperial Buildings, Ludgate Circus, London, E.C.

Engines (Traction).
Jno. Fowler & Co. (Leeds), Ltd., Steam Plough Works, Leeds.
Garrett & Sons, Ltd., Richard, Leiston, R.S.O., Suffolk.

Engravers.
Jno. Swain & Son, Ltd., 58, Farringdon Street, London, E.C.

Fans, Blowers.
Davidson & Co., Ltd., "Sirocco" Engineering Works, Belfast, Ireland.
James Keith & Blackman Co., Ltd., 27, Farringdon Avenue, London E.C.
Matthews & Yates, Ltd., Swinton, Manchester.

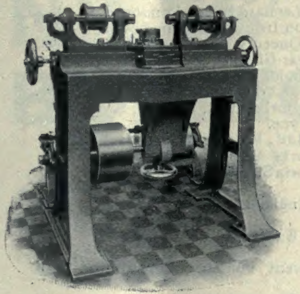
Fire Bricks.
J. H. Sankey & Son, Ltd., Essex Wharf, Canning Town, London, E.
E. J. & J. Pearson, Ltd., Stourbridge.

Firewood Machinery.
M Glover & Co., Patentees and Saw Mill Engineers, Leeds.

PAGE'S WEEKLY Miscellaneous

Cunliffe & Croom, Ltd.,

BROUGHTON LANE,
Manchester.



Double Brass Finishers' Milling Machine.

Write for New List of Tools for

Brass Finishers.

Write for Prices and Particulars
. . OF OUR . .

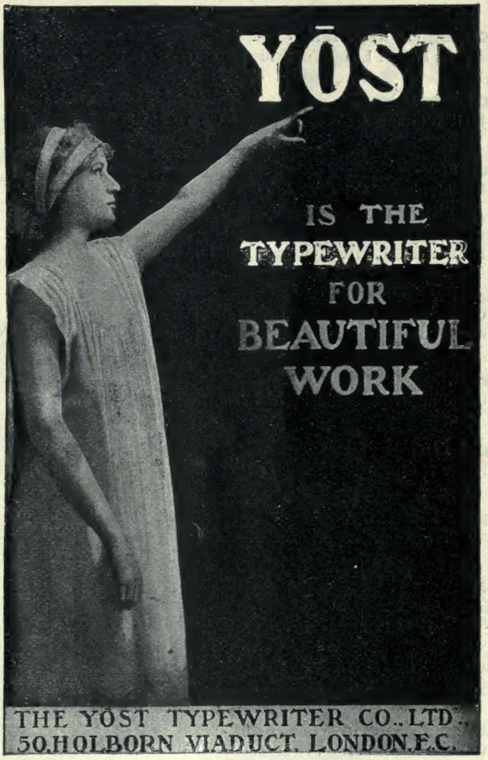
NEW "STANDARD" MACHINES.

They will interest you.

Dynamos "P.D.M." Motors

BEST MATERIAL, WORKMANSHIP, AND DESIGN.

PHŒNIX DYNAMO MFG. CO., Ltd.,
Thornbury Works, BRADFORD.



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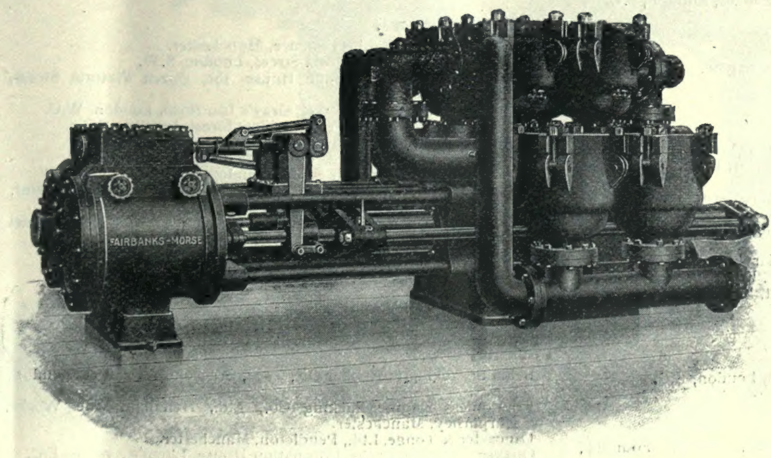

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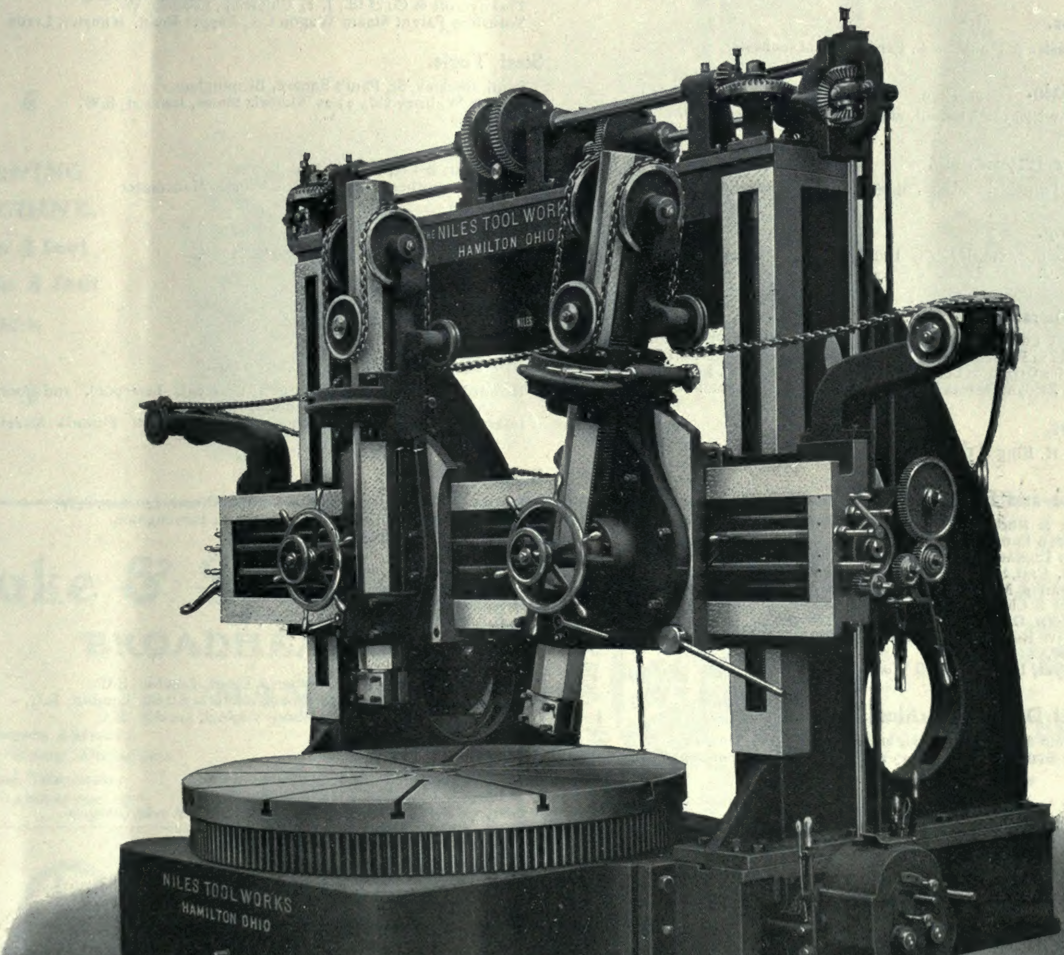

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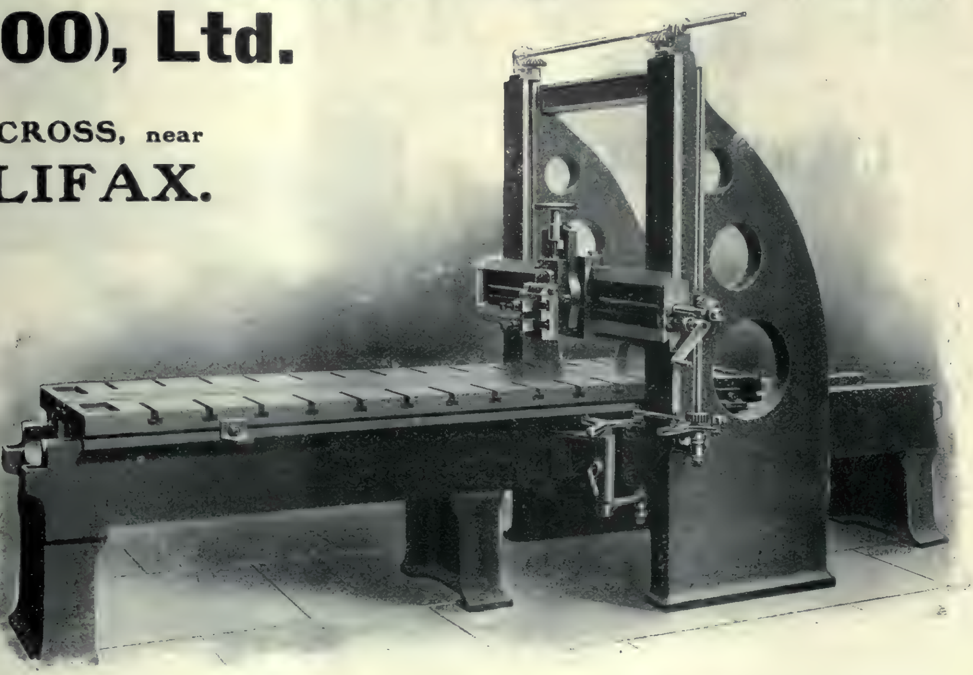

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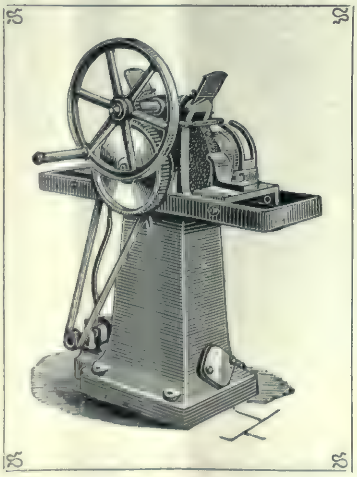

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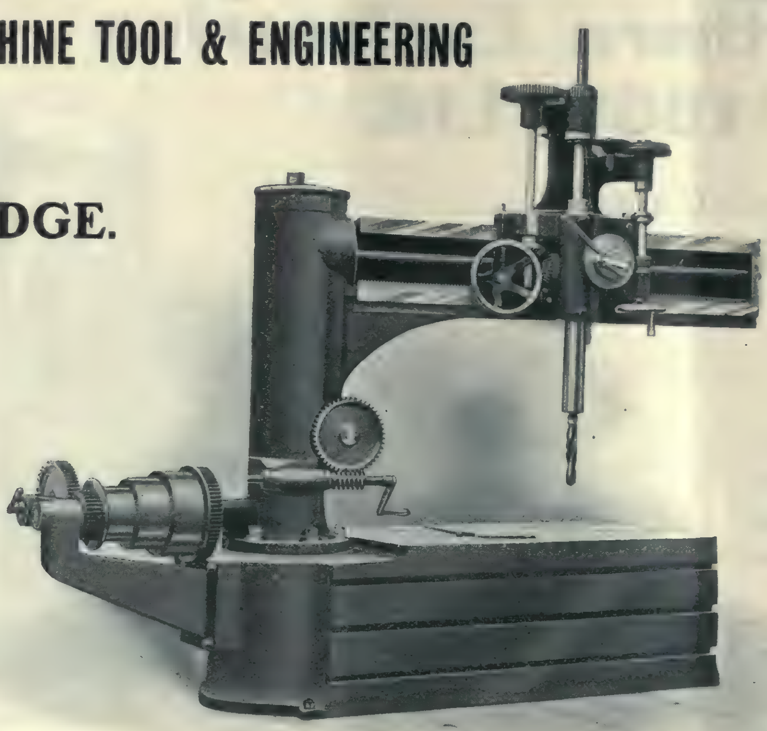

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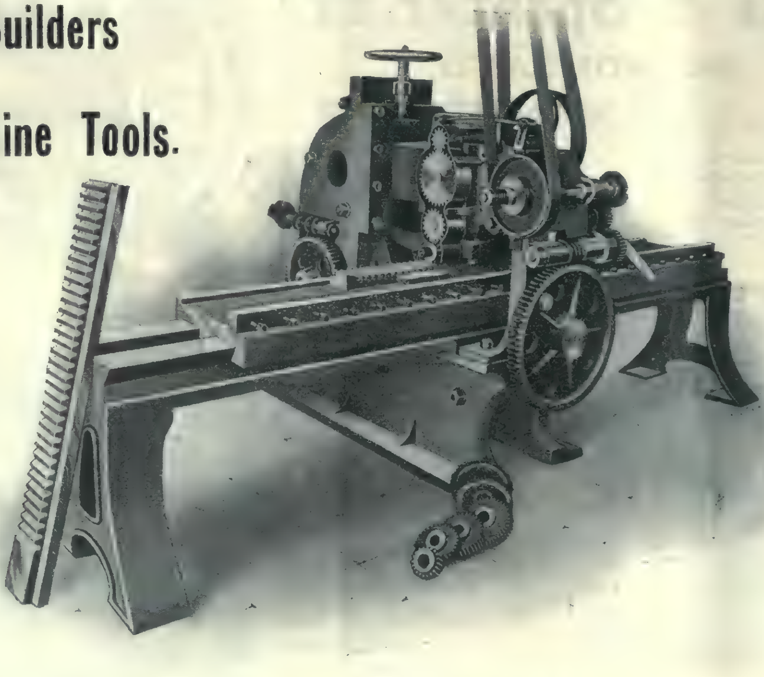

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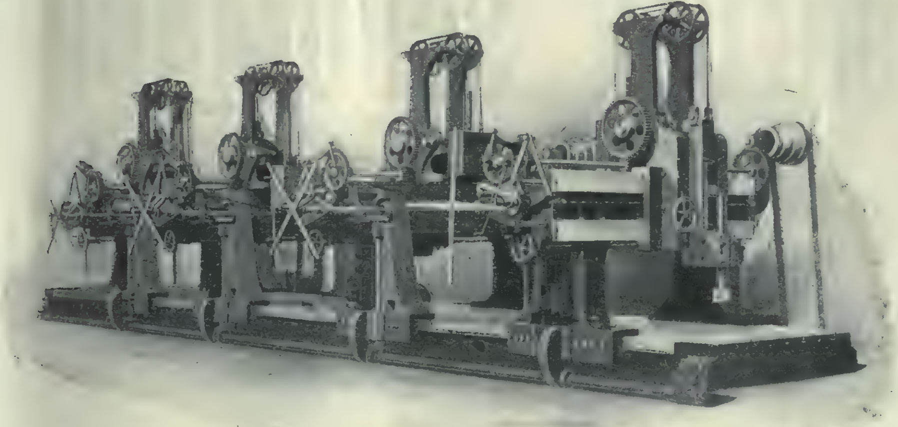

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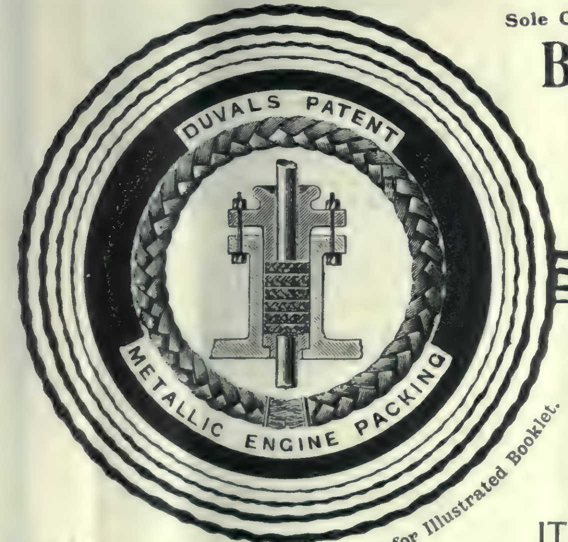

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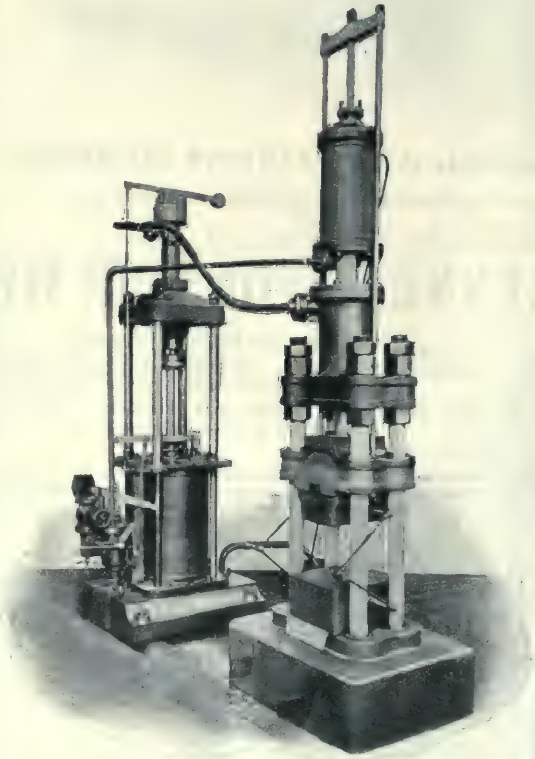

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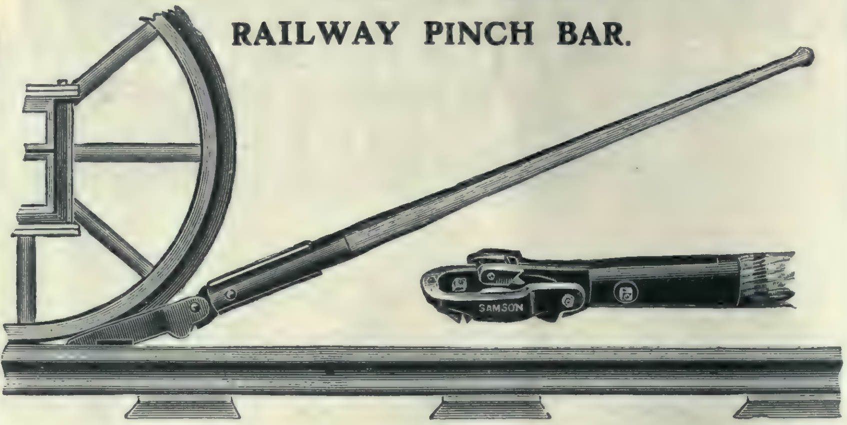

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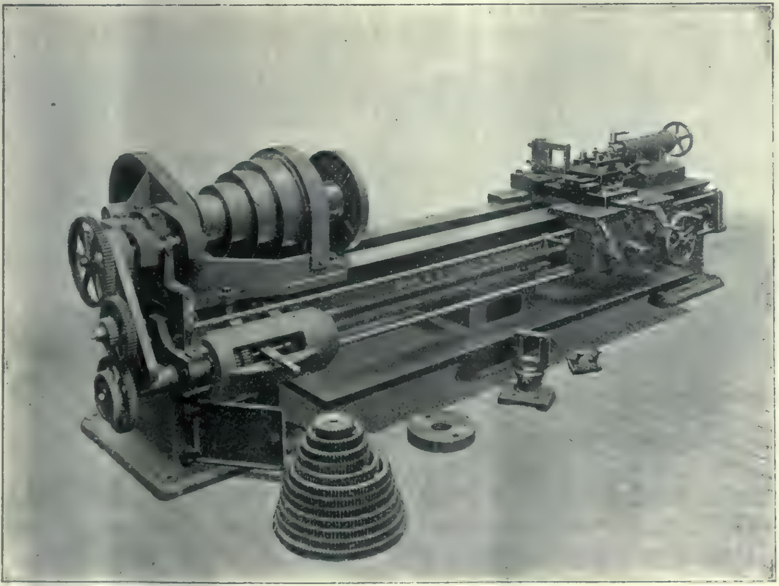

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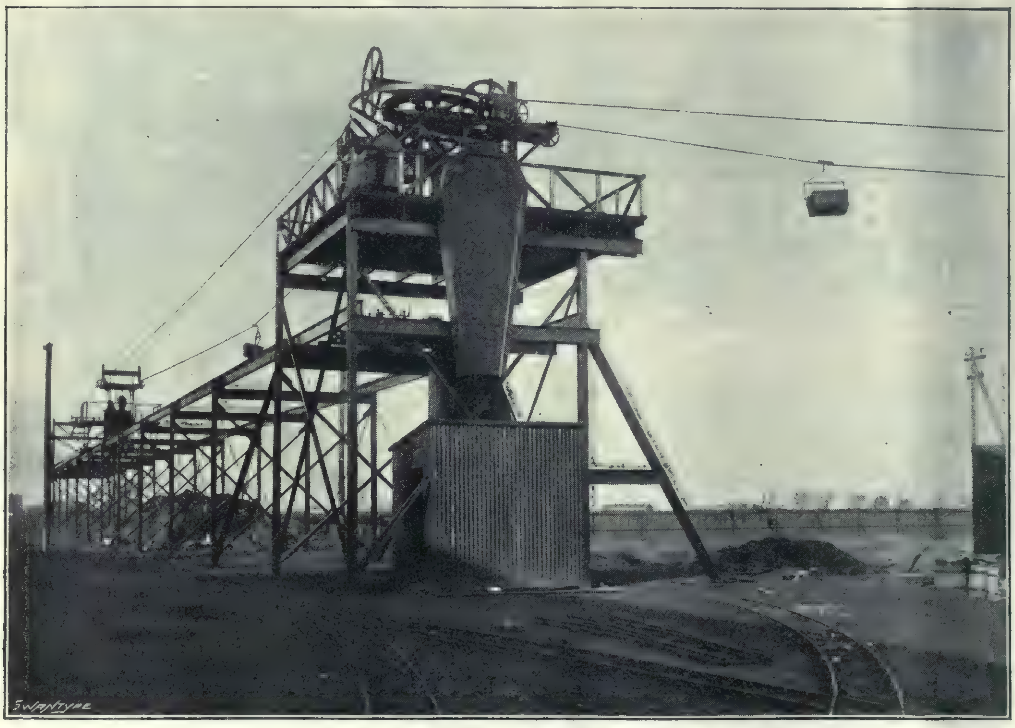

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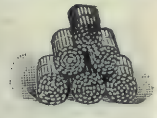

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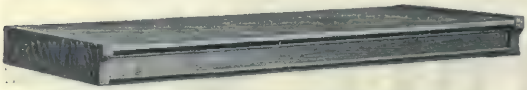

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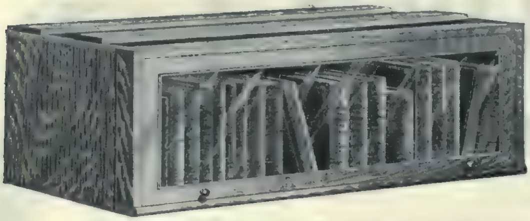

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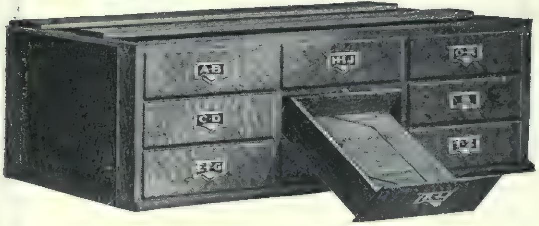

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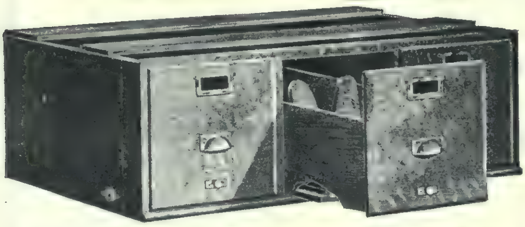

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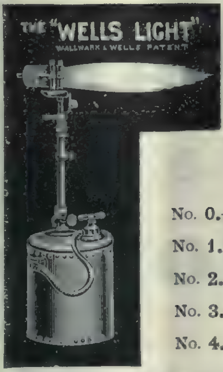

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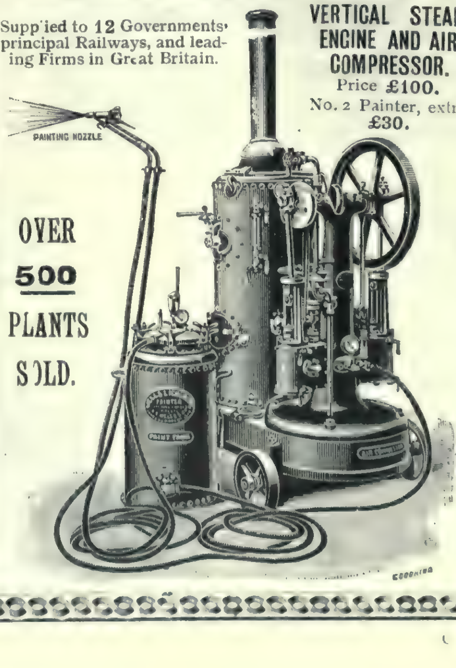

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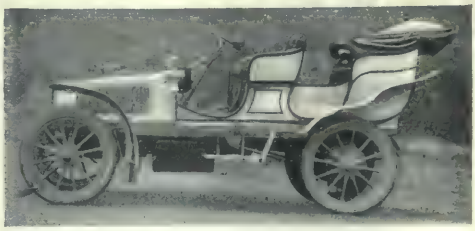

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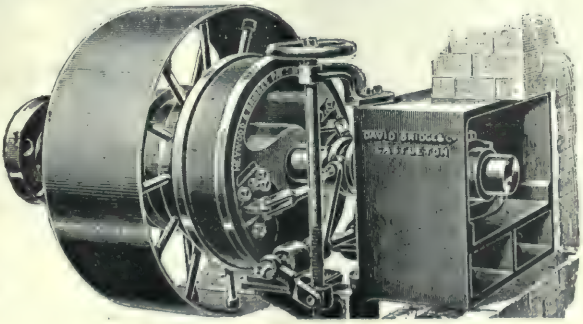

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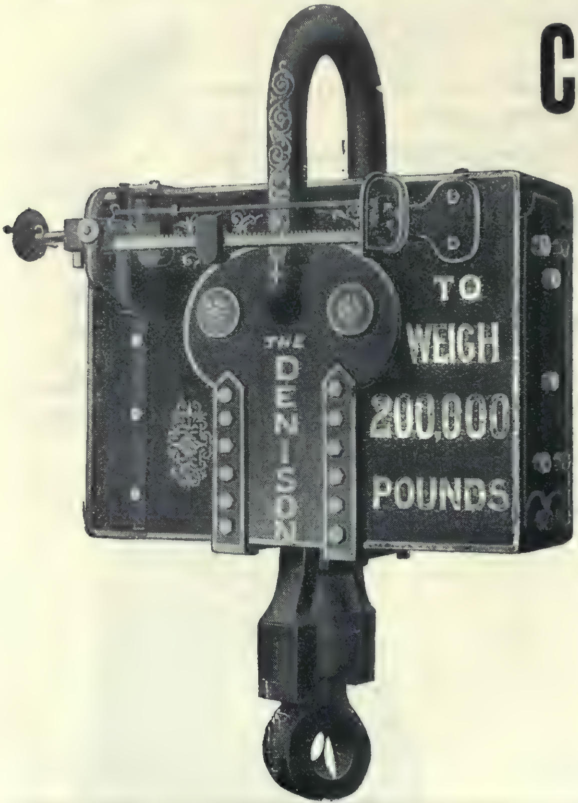

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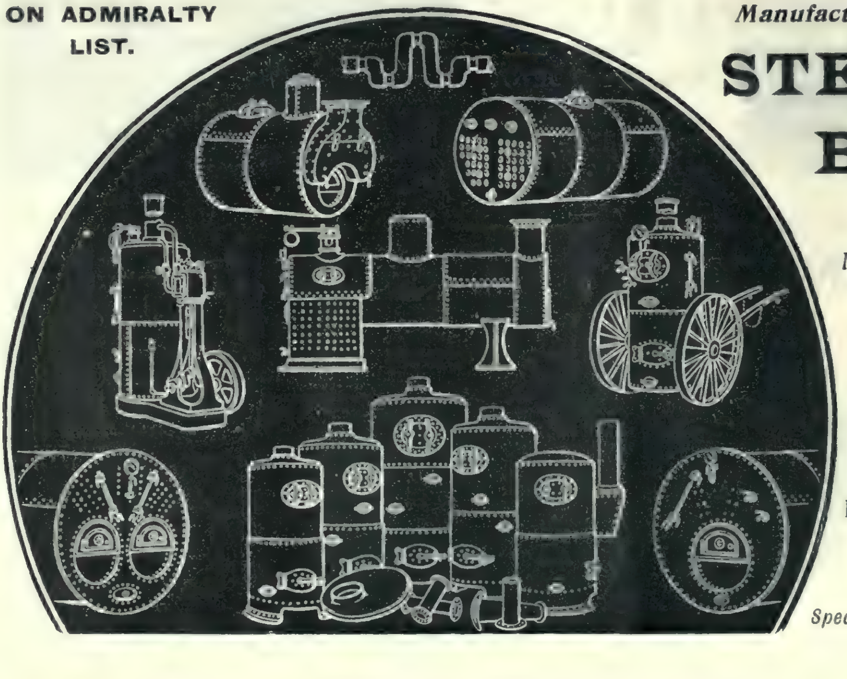

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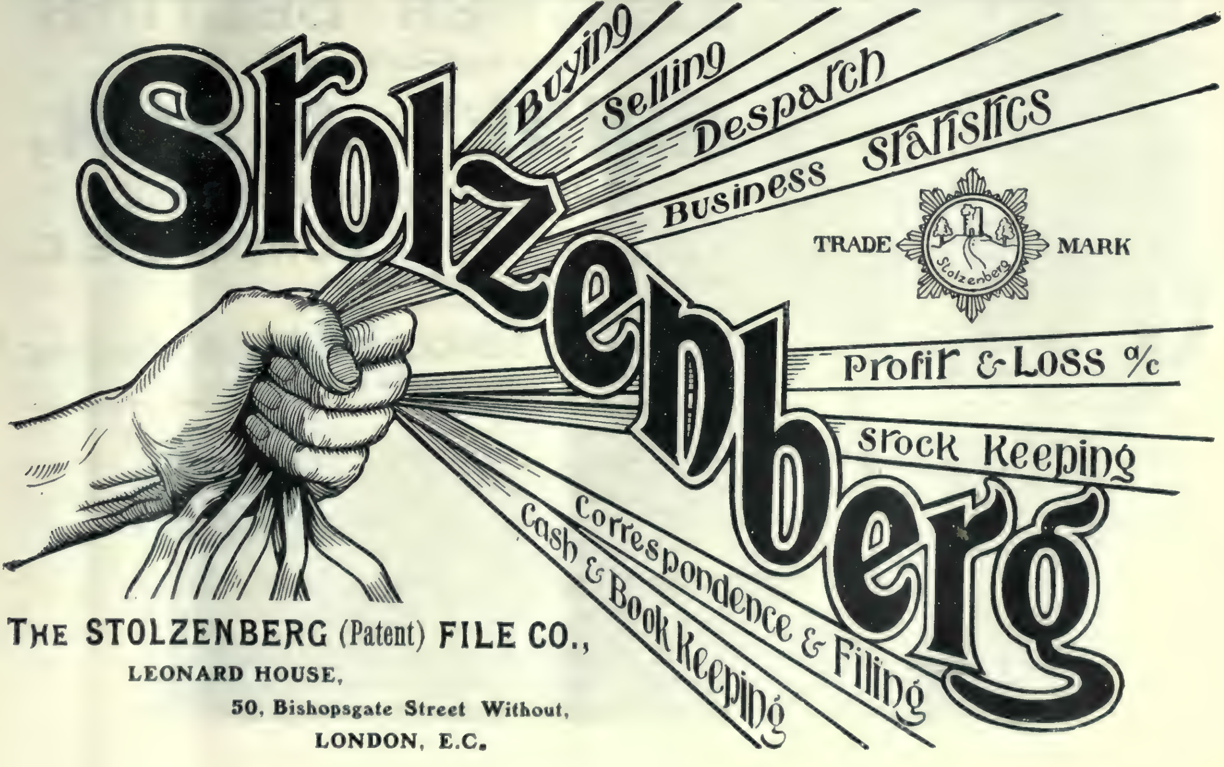

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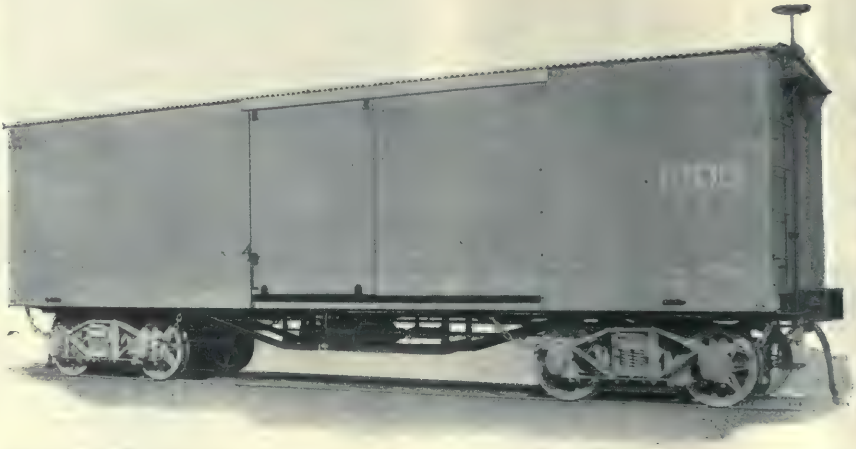

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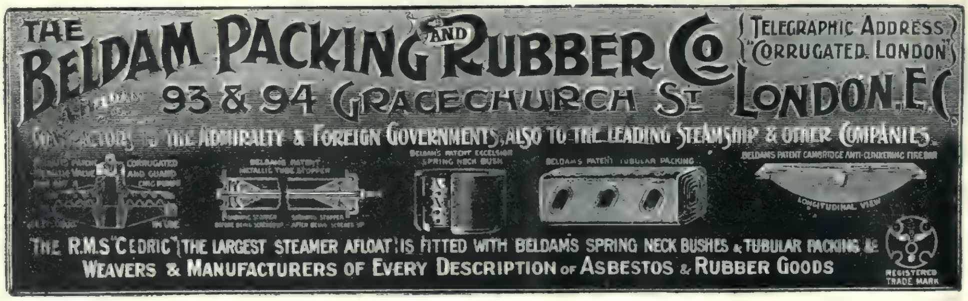

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PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

Vol. V. LONDON, FRIDAY, NOVEMBER 4, 1904. No. 8.

The Offices of "Page's Weekly," Wednesday, Midnight.

THE word "breakdowns" is a word of ill-omen to the steam user, or, indeed, to the employer of any form of machinery. But whereas the temporary obliteration of a process machine from the production lists may be a small matter, the stoppage, even for a short time, of the general prime mover, is always a serious one. The sudden silence where the moment before the deep hum of hundreds of revolving belt pulleys filled the air; the blank faces of the workmen who see an unpleasant shortage on pay-day looming ahead; and, finally, the quick step of the master who has left his engagements to hold a drum-head courtmartial on the spot—all these automatically occur within the first minute of the stoppage. And then comes the trouble, and generally a good deal of it. Of course I am not now speaking of marine breakdowns, whereby the life of every person on board may be jeopardised, until by some marvel of inventive skill and dogged perseverance the fractured screw-shaft is precariously patched up, or the fouled propeller-blade renewed. Nor do I propose to here speak of the agonising details attendant upon a boiler explosion, but simply of the ordinary circumstances of a factory breakdown.

Looking through a list of more than 150 recorded breakdowns of prime movers, I see five attributed to failures of the flywheel. Now

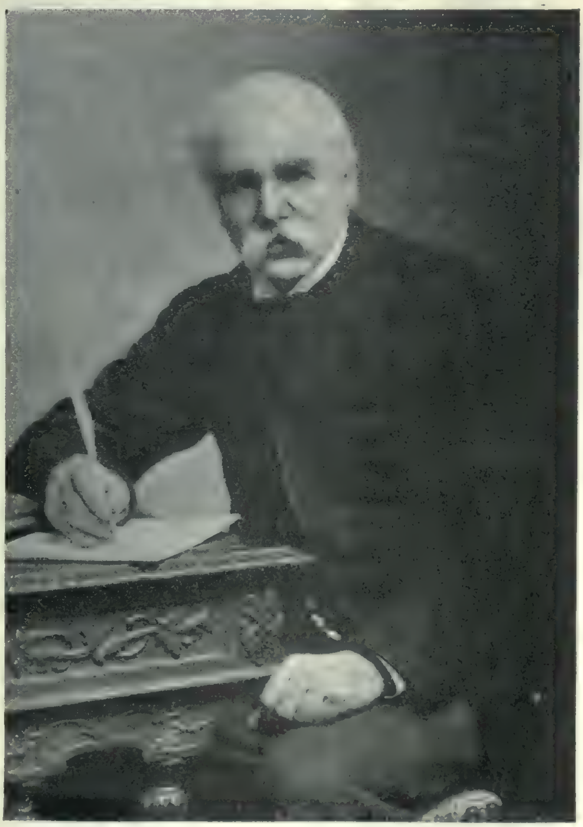


Photo by Elliott and Fry].

SIR GUILFORD LINDSEY MOLESWORTH, K.C.I.E.

The new President of the Institution of Civil Engineers, whose presidential address appears on page 552.

the breakdown—or, perhaps, one should say the break-up—of a flywheel, when it does occur, is the most serious and destructive form of accident which can befall a steam engine; and the object of these remarks is to show that very many steam users are sailing much nearer the wind in this respect than they have any idea of.

With the modern expansive single-cylinder steam engine running at a fairly high speed of piston, the power held in reserve is enormous, comparatively to the power developed at the normal rate of expansion. It is held in check by the restraining influence of the governor, which doles out at each stroke the exact quantity of steam required to keep the engine running at the assigned speed of rotation. Considering that the governor itself owes its motion, and thereby its controlling power, to either a leather belt or a pitch chain or else to cast-iron gearing—the two latter being "positive drives," and held in much esteem now-a-days for that reason—and knowing that the failure of any one of these means of connection may in a moment transform the quietly-running and tractable engine—the obedient and faithful servant of, perhaps, a score of years past—into an ungovernable monster madly bent on self-destruction—it may be well for the reader if he be a user of steam power to closely examine into the security of his governor transmission and consider whether it is all that it should be.

No single leather belt should ever be relied upon for driving the governor of an engine of any size. A pair of belts running upon double pulleys side by side—either, of course, being adequate for the work to be done—afford a very reasonable degree of security, provided they are well looked after. And while dealing with the belt, or chain-connected governor, I may mention that it is perfectly easy to apply a weighted lever (the weight taking the form of a heavy pulley running upon the belt or chain) which, if the belt breaks or slips off shall suddenly fall and close the throttle valve. There are also means for attaining the same result in a gear-driven governor. If the teeth of the gear are worn, a tooth may break off and lodge in the space between two of its neighbours, when a smash is certain to result — the governor drops, owing to the sudden stoppage, to lower than its normal lowest point, and trips a catch which closes—or prevents from opening—the steam-inlet valves. None of these simple safeguards are in any degree costly, and even if never brought into use convey a feeling of security which is very good value for the outlay.

The weak spot in the flywheel itself and the forces which are let loose by its failure for destructive purposes will be considered in succeeding notes.

Referring to the interview with Mr. McDermid, the secretary of the Institution of Mining and Metallurgy, on the question of the proposed amalgamation of Mining Institutes which appeared in our issue of October 21st, I have received some correspondence relative to the rules governing admission to the two Institutions. It will answer several correspondents if the rules are quoted *in extenso*, and this I have accordingly done.

The following is the rule under which members are admitted to the Institution of Mining and Metallurgy:—

"Every candidate for admission into the class of Members, or for transfer into that class, shall come within one of the following conditions: He shall be not less than thirty years of age, and shall have been for at least five years in a responsible position with regard to, and shall be at the time of his candidature occupied in, practical mining or metallurgical work; or, he shall prove to the satisfaction of the Council that he is a fit and proper person, by

Photo by Elliott and Fry.]

THE HON. CHARLES A. PARSONS, M.A., D.SC., F.R.S., J.P.,
Whose remarks on British Patents will be found on page 521.

reason of his attainments, to become a Member."

Associates must be over twenty-five years of age, and have been engaged in practical mining or metallurgy for at least three years.

In the case of the Institution of Mining Engineers, the following are the principal rules governing membership:—

"Each Ordinary Member shall be more than twenty-three years of age, have been regularly educated as a mining, metallurgical, or mechanical engineer, or in some other branch of engineering, according to the usual routine of pupilage, and have had subsequent employment for at least two years in some responsible situation as an engineer; or, if he has not undergone the usual routine of pupilage, he must have been employed or have practised as an engineer for at least five years."

"Each Associate Member shall be a person connected with or interested in mining, metallurgy, or engineering, and not practising as a mining, metallurgical, or mechanical engineer, or some other branch of engineering. Associates shall be persons acting as under-viewers, under-managers, or in other subordinate positions in mines or metallurgical works, or employed in analogous positions in other branches of engineering."

Statistics issued during the week serve to indicate in an interesting manner the relative risks of fatal accident when travelling by sea, rail, or ordinary thoroughfare. One of these returns shows the number of lives lost by wreck, drowning or other accident at sea and in rivers and harbours in British seagoing merchant ships registered in the United Kingdom. During 1903 the masters and seamen employed numbered 233,482, while the lives lost by drowning or wreck numbered 1,008. The masters and seamen lost by accidents other than drowning with wreck numbered 231, thus bringing the total to 1,239. This total is equal to ·53 per cent. of persons employed, or 1 in 188. Of the lives lost, 1,239 were members of crews, 57 being passengers. It is gratifying to note that the percentage has gone steadily down since 1891, when it stood at ·88, or 1 in 114. In 1902, however, the percentage was ·51, or 1 in 195, and the year's total still points to the need which exists for improvements in nautical appliances and methods.

A report just issued by the Commissioner of Police of the Metropolis shows that during the same year in the streets of London 10,202 persons were injured, and 154 killed, thus indicating that there may be worse places even than the sea. Perhaps one is as safe in a railway train as anywhere. For the same twelve months the report of the Board of Trade on railway accidents shows that the number of passengers killed by accidents to trains, rolling stock, permanent way, etc.—*i.e.*, accidents for which the companies could fairly be held responsible—in the United Kingdom was only 25. In the previous year the figure was only 6. I may as well add that the total number of people killed, including servants, suicides, trespassers, etc., during last year was 1,159.

The Great Northern, Piccadilly and Brompton Railway, extending from Finsbury Park to Earl's Court, with a branch from Holborn to the Strand near to Somerset House, will probably be in working order by Christmas, 1905. The Charing Cross, Euston and Hampstead Railway, extending from the front of Charing Cross Station to Golder's Green, will be ready by the summer of 1906; and the overground light railway from Golder's Green to Hendon and Edgware will probably be opened shortly afterwards. Further, during the next few years the London United Tramways will build a number of extensions which will serve as additional feeders to the District Railway.

NEWS OF THE WEEK.

I REGRET to hear that Sir Lowthian Bell has just undergone an operation for cataract. His numerous friends will join with me in wishing Sir Lowthian a speedy recovery.

Messrs. Charles Connell and Co., Ltd., Whiteinch, Glasgow, successfully launched a few days ago the steel screw steamer *Franklyn*, built to the order of the Palace Shipping Company, of which Messrs. McVicar, Marshall, and Co., Liverpool, are managers for their general cargo traffic. The dimensions are: Length, 400 ft.; breadth, 52 ft.; and depth, 31 ft. 3 in. She has a gross tonnage of about 4,950 and a deadweight carrying capacity of about 8,000 tons.

Our Canals.

The Woking, Aldershot, and Basingstoke Canal was put up for auction a few days ago, but bidders were not forthcoming. The canal, as the auctioneer explained, was constructed under two Acts of Parliament passed in the reign of George III., and was built at a cost of between £150,000 and £200,000. It was opened in 1794, starting in the town of Basingstoke, and, passing through some of the most picturesque and beautiful residential neighbourhoods of Hampshire and Surrey, it ended at the junction of the river Wey, by means of which a direct line of navigation was opened to London, a distance of nearly seventy miles. The canal is about thirty-seven miles long, and there are twenty-nine locks. The traffic was at the outset very remunerative, but when the South-Western Railway was constructed it gradually seemed to "swamp" the canal. It was remarked that the canal might be converted into a motor track, but this ingenious suggestion did not prevent the property being withdrawn.

Business and Professional.

Mr. Ralph H. Haylock, 63, Queen Victoria-street, London, E.C., has been appointed sole agent for London and the southern counties for the sale of Mr. George's Addy's high-speed tool steel "Z" brand.

Messrs Alley and Machellan, Ltd,, of Glasgow, have just received an order to supply two of their "Sentinel" patent compound intercooling air compressors for Messrs. William Beardmore and Co.'s (Ltd.) new shipyard at Dalmuir. These machines are of size No. 8 double, having a total capacity of 5,500 cubic feet per minute at standard speed. They will be coupled direct, each to a 400 b.h.p. Ochelhauser gas engine, supplied by Messrs. D. Stewart and Co. (1902) Ltd.

The compressors will each supply air at 30 lb. and 100 lb. per sq. in., the return from the 100 lb. service being led to the 30 lb. reservoirs, and the air supply will be automatically controlled by governors at both these pressures.

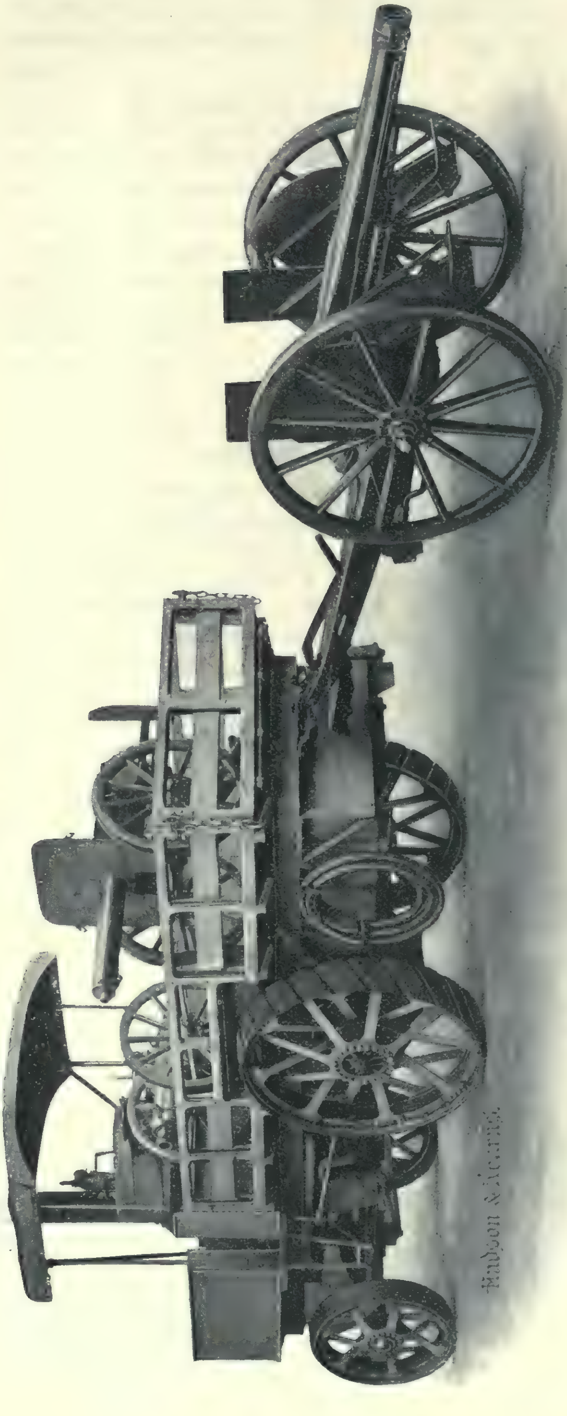
The compressors are Messrs. Alley and Machellan's standard enclosed type, all bearings being lubricated under pressure. This will probably be the largest gas engine-driven compressed air installation in the country, and is, probably, the most completely organised.

Asiatic Labour in the Transvaal.

In spite of the favourable reports from South Africa as to the working of Chinese labour, we still hear in London some very short-sighted indictments of the system. A few days ago, at a meeting of the New Reform Club, Mr. R. L. Outhwaite remarked that there were two ways in which the labour difficulty could have been solved without importing Asiatics—either by getting further Kaffir labour, or by the employment of white labour. The conclusion he had come to was that the mineowners had failed to prove that they could not obtain a sufficiency of Kaffir labour, given proper and satisfactory conditions of working. The real solution of the difficulty was the introduction of labour-saving machinery and the employment of highly skilled white labour. That that was a practicable and not an unprofitable solution had been proved out of the mouths of the mining engineers themselves. But the mineowners had incurred such gigantic liabilities that it was an absolute necessity from their point of view that they should have the cheapest possible form of labour, and it was to meet that necessity that they insisted upon having indentured Chinese. The Transvaal had been converted into what could only be described as a huge convict settlement, and the effect of this must be to rot and damn absolutely the whole place. It had created a situation pregnant with dangers of the most serious character. He believed the ultimate outcome would be that the Chinese would have to be swept out of the country, and the colony reconstructed on lines altogether different from those which had been, and were still being, adopted by Lord Milner.

A New Type of Motor Steam Wagon.

We illustrate this week Messrs. Thornycroft and Co.'s new 5-ton steam wagon, which was exhibited at the recent Brewers' Exhibition, where it attracted a good deal of notice. The boiler is of the locomotive fire-tube type, but of special design, steam being maintained at the working pressure at 175 lb. per square inch. The fire-grate is arranged to be lowered at will by the driver to facilitate the cleaning or removal of the fire. The engine is of the horizontal compound reversing type, with constant lead radial valve gear of special design, providing for any degree of "linking-up." The cylinders are of 4½ in.. and 7 in. diameter respectively, the stroke being 7 in., and at normal speed of 500 revolutions per minute the engine develops about 45 h.p.



THORNYCROFT STEAM WAGON FOR GUN TRANSPORT.

The transmission of power from the engine to the road wheels is by the Thornycroft patented system of gearing, no chains being employed. This special arrangement permits of a "play" of 7 in. or 8 in. between axle and frame of wagon, without disturbing in the slightest the steady continuity of the driving effort, and without the possibility of any jump in the gearing. A normal and low-speed gear are provided, the latter being intended for hill climbing.

The steering is on the divided axle principle, the gearing being a worm, and quadrant operated by the usual band wheel

By the courtesy of Messrs. Thornycroft we also illustrate herewith, their latest gun-transport wagon.

The Simplon Tunnel.

A special correspondent in the Times on Wednesday gave an explanation of the delay in completing the main boring of the Simplon Tunnel. It was calculated that this would be completed by the middle of October, and that six months would suffice for the enlargement of the original heading to full size, and for the laying of a single track, so that the line would be open for traffic in the spring of next year. But a series of unexpected events has entirely upset these anticipations, and has introduced so much uncertainty as to the future progress of the boring that the authorities are no longer able to estimate the time that will be required to finish the work

The Construction of the Tunnel.

It will be remembered that the construction of the tunnel has been carried on from both ends simultaneously, a boring from Brig on the Swiss side rising with a gradient of 1 in 500, and one from Iselle on the Italian side with a gradient of 1 in 143. The summit is at a point 9·572 kilometres from the Brig portal, or 10·197 kilometres from Iselle, and there a crossing place is to be provided so that trains may pass each other, until the volume of traffic is such as to require a double track throughout. From both sides two parallel headings have been driven simultaneously, with numerous cross-connecting passages; this plan was adopted primarily to facilitate the work of construction, but the auxiliary heading will serve for the second line of rails when a double track becomes necessary. At the present time the main Swiss heading has been carried over the summit and ends on the Italian side at a point 10·382 kilometres from the Brig portal, while the Italian main heading had, at the middle of October, reached a point 9·140 kilometres from Iselle. Thus there remain 247 metres to be excavated before the headings meet.

The Swiss Side.

The writer gives a succinct account of the difficulties which led to the abandonment of further operations in the Swiss headings in May last. When two hot springs, yielding 480 gallons a minute, were met with at kilometres 10·378 at the extreme end of the main heading, it was felt to be impossible to continue the work, and this view was clinched a day or two later when, as a result of an Alpine storm and a landslip, the water supply at the intake above Moerel was cut off, together with the chief motive power of the machinery at Brig, upon which depended the ventilation, refrigeration, and drainage of all the tunnel workings on the Swiss side. On May 18th, therefore, all work in the advance headings was hastily abandoned, and the iron gates closed behind the retreat will presumably remain closed until the boring is achieved from the Italian side.

The Italian Side.

With regard to the operations on the Italian side, the new 960 gallon spring which has been encountered has proved to be rather hotter than the last spring of the Swiss heading, and, consequently, it is felt to be doubtful whether the expected decrease of temperature will be found to exist. In the event of much hot water being met with, the difficulties of the situation will be enhanced by the fact that there is nothing in the Italian workings comparable to the extensive plant which was available at the Swiss end for dealing with such a contingency. It is possible, however, in spite of the little relation which appears to exist between adjacent springs, as judged from their great variations in hardness and temperature, that in the sponge-like formation of the mountain mass connections do exist between them, and that some of the percolations in the Italian headings may be accounted for in rock of such soluble character as is here encountered, by the big well of water now constituted by the submerged headings of the Swiss side.

The Meeting of the Two Headings.

Gradually, as the Italian headings approach the abandoned Swiss workings, the danger will increase with the difficulties, for the crown of the Italian tunnel "No. 1" will eventually cut into the floor line of the corresponding advance-drift on the Swiss side, which has been driven upwards on a constructional incline, and is, therefore, not in due alignment. At that time the Swiss plant will be set to work to drain, if possible, the flooded headings, and the success of the final operations will depend in large measure upon how large a hole can be blown by the last plant in the intervening diaphragm of rock, since, if only a small hole is made, great trouble may be experienced in enlarging it in face of the inrushing flood of hot water. But at that moment the great refrigerating plant of the Swiss side will be able to give appreciable help to the engineers in the Italian headings. If the difficulty of a direct encounter of the two main headings becomes very serious, other means can be employed to evacuate the body of water accumulated in the Swiss workings. For instance, the auxiliary "No. 2" heading can be advanced until it taps the "reservoir" at a relatively higher level, for the drifts will then be in due alignment; or a middle drain way advanced between the two tunnels in front of the two main headings, would free them of much of the hot water. As may be supposed, many plans have been thought out to meet the local conditions as they arise, but, as has always been the case, "No. 2" tunnel will become the great drain into which the bulk of the water will promptly be diverted by the first convenient cross passage, and once more the necessity will be demonstrated for a second or auxiliary tunnel.

The New Manager of the Underground.

I am glad to note that the appointment of Mr. John Young, as manager of the Underground Railway Company of London, is meeting with very warm approval. On the authority of Mr. R. K. Gray, President of the Institution of Electrical

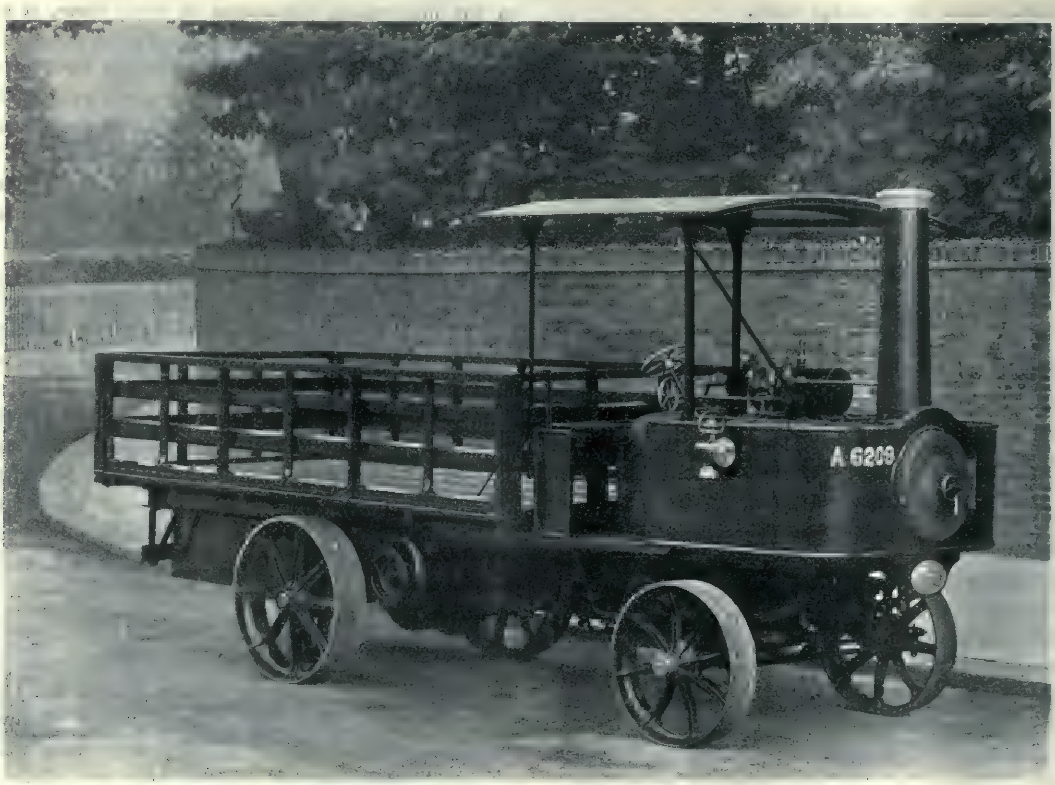
Engineers, we have it that Glasgow has the finest electric tramway system in the world, and as my readers will remember, Mr. Young was responsible for the inauguration of the Glasgow scheme.

The Association of Technical Institutions.

An organisation which has been doing a good deal of useful work in an unobtrusive manner during the last ten years is the Association of Technical Institutions. Prof. J. Wertheimer, B.Sc., B.A., who inaugurated the Association, and was for a long period its hon. secretary, now acts as Chairman of the Council, while Mr. G. H. Pope, M.A., B.C.L., J.P., D.L., and Principal S. H. Wells, are respectively Treasurer and Secretary. As far back as 1893 it was felt that those engaged in the work of technical education ought to be in a position to speak collectively when necessary, hence the formation of the association. Its objects are: (*a*) To provide a medium for the interchange of ideas among its members; (*b*) to influence, by combined action where desirable, Parliament, county councils, and other bodies concerned in promoting technical education; (*c*) to promote the efficient organisation and management of technical institutions, facilitate concordant action among governing bodies, and aid the development of technical education throughout the United Kingdom.

Sir John Gorst, K.C., M.P., is the President of the the Association. His predecessors in office were: Sir William Mather, M.P., the late Right Hon. A. J. Mundella, M.P., the Right Hon. Henry Hobhouse, M.P., the Right Hon. Sir Bernhard Samuelson, Bart., F.R.S., the Right Hon. Earl Spencer, K.G., Sir Swire Smith, the Right Hon. Sir William Hart Dyke, Bart., M.P., the Right Hon. Lord Avebury, D.C.L., F.R.S., and Sir John Wolfe-Barry, K.C.B., F.R.S.

The excellent photographs of Vice-Admiral Sir Archibald Douglas and Sir Lowthian Bell, which appeared in our last issue, were taken by Messrs. Elliott and Fry, who are also responsible for the photos of Sir Guilford Molesworth, the Hon. C. A. Parsons, and Mr. Henry Davey, which are included in this number.



NEW TYPE OF 5-TON THORNYCROFT STEAM WAGON.

QUESTIONS OF THE DAY.

II.—The National Encouragement of the British Inventor: How Can it be Secured? (*Continued from page* 477).

MR. B. H. Thwaite, C.E., F.C.S., has favoured us with some further opinions on this important question, more particularly as to the constitution of the examining staff necessary to carry out the provisions of the new Act, and the State encouragement of inventors. Says Mr. Thwaite :—

WANTED—A COUNCIL OF PRACTICAL EXPERTS.

It is well-known that generally practical men can alone determine the measure of novelty and importance of an invention, and this fact raises the question of the measure of competency of the examining and searching staff to be appointed to carry into effect the provisions of the new act. The ability to pass an ordinary Civil Service exam. will be a poor mental equipment for a man who has to differentiate between one invention and another. Such a staff may become competent to make a preliminary search and report, but there should be appointed in addition a council of practical experts to supervise the findings of the preliminary examiners.

MEDALS AND PRIZES FOR IMPROVEMENTS.

In addition the Government should set aside a grant to provide medals and other prizes to be given annually by the Council of Experts, to the inventor, if any, of the most important improvement in the various branches of industry. This policy of inventive encouragement has a parallel in the action of the Government of the famous Franklin Institute. The recipient of such a medal, or other form of recognition, would be greatly encouraged, the system would effectively promote the exercise of the faculty of invention so widely possessed by the members of the British race.

Further, if a poor inventor finds that a wealty corporation or firm is infringing his patent, he should be allowed to state his case before the permanent council of experts—appointed by the Government—and if he establishes his claim for consideration, the Government should appoint counsel to act for him, just as would be done in the case of divorce under the *in forma pauperis* regulations.

ANOTHER INVENTOR'S VIEWS.

The Hon. Charles A. Parsons writes :—

Holeyn Hall,
Wylam-on-Tyne,
October 26th, 1904.

To the Editor of PAGE'S WEEKLY.

Dear Sir,—I have pleasure in sending you a copy of my address to Section G, British Association, 1904, which briefly gives my views. The new patent act seems to me to be a step in the right direction. It is, however, a small step, and I entertain no doubt that within the next half century we shall find "inventions" fostered by Governments generally and not placed under very great disadvantages as has hitherto been the case. I consider the general encouragement of invention will be one of the greatest steps in advancement of the human race that will take place during this century.

I remain,
Yours faithfully,
Charles A. Parsons,

Extracts from the above-mentioned paper follow :—

THE REAL NATURE OF AN INVENTION.

Let us for a moment consider in what invention really consists, and let us dismiss from our minds the very common conception which is given in dictionaries and encyclopædias that invention is a happy thought occurring to an inventive mind. Generally, what is usually called an invention is the work of many individuals, each one adding something to the work of his predecessors, each one suggesting something to overcome some difficulty, trying many things testing them when possible, rejecting the failures, retaining the best, and by a process of gradual selection arriving at the most perfect method of accomplishing the end in view.

COST OF SEARCHING.

What a waste of time, expense, and disappointment would be avoided if we in England helped the patentee to find out easily what had been done previously, on the lines adopted by the United States and German Patent Offices, who advise the patentee after the receipt of his provisional specification of the chief anticipatory patents, dead or alive! And ought we in England to rest content to see our patentees awaiting the report of the United States and German Patent Offices on their foreign equivalent specifications before filing their English patent claims? Ought not our Patent Office to give more facilities and assistance to the patentee?

Very many inventors avoid the expense of searching the patent records to see how far their problem has been attacked by others. In some cases the cost of a thorough search is very great indeed; sometimes it is greater than the cost of a trial attack on the problem. In the case of young and inexperienced inventors there sometimes exists a disinclination to enter on an expensive search; they prefer to spend their money on the attack itself. There are some, it is true, who have a foolish aversion to take steps to ascertain if others have been before them, and who prefer to remain in ignorance and trust to chance. It will, however, be said that the United States and German Patent Office reports ought to suffice to warn or protect the English patentee; but my own experience has been that such protection is not entirely satisfactory. There is, first, a considerable interval before such reports are received, and the life of a patent is short. Then, if the patent is upon an important subject, attracting general attention, the search is vigorous and sometimes overwrought, and the patent unjustly damaged or refused altogether. If, however, the patent is on some subject not attracting general attention, it receives too little attention and is granted without comment.

In some few instances it may be said that ignorance has been a positive advantage, and that if the patentee had realised how much of his patentable work was honeycombed by previous publications and patents, he would have lost heart and given up the task. It is, I think, a case of the exception proving the rule; and the patentee ought, as far as possible, in all cases to know his true position, and make his choice accordingly.

ANTICIPATIONS.

The present patent law has some curious anomalies. Let us suppose some inventor has the good fortune to place the keystone in the arch of an invention, to add some finishing touch which makes the whole invention a complete success, and valuable. Then, success having been proved possible, others try to reap the results of his labour and good fortune, and, as often happens, it is discovered after laborious search that someone else first suggested the same keystone in some long-forgotten patent or obscure publication, but for some reason or other the public were none the better for his having done so. What does the law do? It says this is an anticipation, and instead of apportioning to all parties reasonable and equitable shares in the perfected invention, to which no one could object, it says that the patent is injured or perhaps rendered useless by the anticipation, and that its value to everyone concerned is thereby diminished or destroyed, as the case may be, and thrown open to the public. Up till a few years ago, any anticipations, however old, might be cited; but recently the law has been amended, and at present none rank as anticipations which are more than fifty years old.

LEGISLATION NEEDED.

Let us ask what change in the laws would place great pioneer research works on a sound financial basis. A Government grant, except for very special purposes, seems to be out of the question, seeing that the benefits to be derived are generally not confined to any one country. An extension of the life of patents, which is now from fourteen to sixteen years in different countries, would be undoubtedly a step in the right direction. It would be of great benefit generally if some scale of duration of patents could be fixed internationally, the scale being fixed according to the subject-matter, the difficulty of the attack, and the past history of the subject, but more especially in view of the utility of the invention.

One of the chief objections raised by the Privy Council against the extension of patents in this country has rightly been that undue prolongation is unfair to the British public, seeing that abroad no prolongations are granted. Therefore, if the duration of patents for important matters is to be extended at home it must also be extended abroad. In other words, such prolongations, to be effective, should necessarily extend to other countries. They should be international, and concurrent in all the countries interested.

THE PROPOSED CENTRAL INTERNATIONAL COMMITTEE.

One possible solution of this difficult question would be to place such matters under the jurisdiction of a Central International Committee, who would have the apportionment of the life and privileges of patents and of the extension or curtailment of their duration, according to their handling by the owners. I would ask, why has a patent a life of only fourteen to sixteen years, while copyright is for forty-two years? Why has a pioneer company making a railway under Act of Parliament generally rights for ever unless it abuses its privileges, or the requirements of the district necessitate the construction of competing lines, while a patent has in comparison a life of infinite shortness.

I might also cite gas companies, electrical supply companies, under Act of Parliament, or provisional orders of forty-two years' duration; and this reminds us of the fact that until the term of life for electric supply companies had been extended from twenty-one years to forty-two years by the bill of 1884, it was impossible to find capital for such undertakings.

Now, it may be urged that the grant of a patent is a different thing from the grant of power to a railway company, a gas or electric supply company. But the object of this address has been to show that a patent, to be fair to the patentee, ought in many cases to be analogous to an Act of Parliament or a provisional order. Would it not place matters in a fairer position, especially in the case of expensive and lengthy researches, to grant to those who pledge themselves to spend a suitable and minimum sum within a stated period on the research a reasonable and fair monopoly, so that such person or syndicate might in the event of success be in the position to reap a reasonable return for their expenditure and risk?

QUESTIONS ON THE PATENT LAWS.

As a basis for discussion, the following questions have been addressed to a number of representative readers:—

1.—Do you consider that the new Act will offer a satisfactory solution to the difficulties of patentees and in what direction do you advocate further legislation?

2.—What is your opinion as to the effect of the yearly fees which, in the event of renewal, are at present payable between the fifth and fourteenth years? Should the British Patent Department be run so as to produce a profit for the Exchequer by the penalising of the inventor? Should the Patent fees be reduced to the proportion of those charged by the American Patent Department?

3.—What do you consider should be the constitution of the proposed searching staff, and how far should the search extend? Do you consider that the examining staff to carry out the provisions of the New Patent Act should be supervised by a council of practical and acknowledged experts, selected by the Government?

4.—How many years do you consider patents should run? Do you think seventeen years' effective duration without further taxation, as in America, an equitable arrangement?

5.—Have you encountered any instances in which our existing patent regulations have strangled an invention?

6.—Do you consider that the term of a patent life should be proportionate to the importance of the invention, and to the time and money expended in its commercial perfection?

7.—Is it your opinion that, when challenged, the inventor should be required, at a certain period of, say, any time after four years from the date of application, by affidavit, to prove that he, the inventor, has done his utmost to secure the commerical working of his invention?

8.—Do you think it advisable that the Patent Department should offer prizes for the encouragement of the inventor?

9.—Do you consider that the life of a patent should date from the time when it is commercially perfected, but limited to a period of seven years?

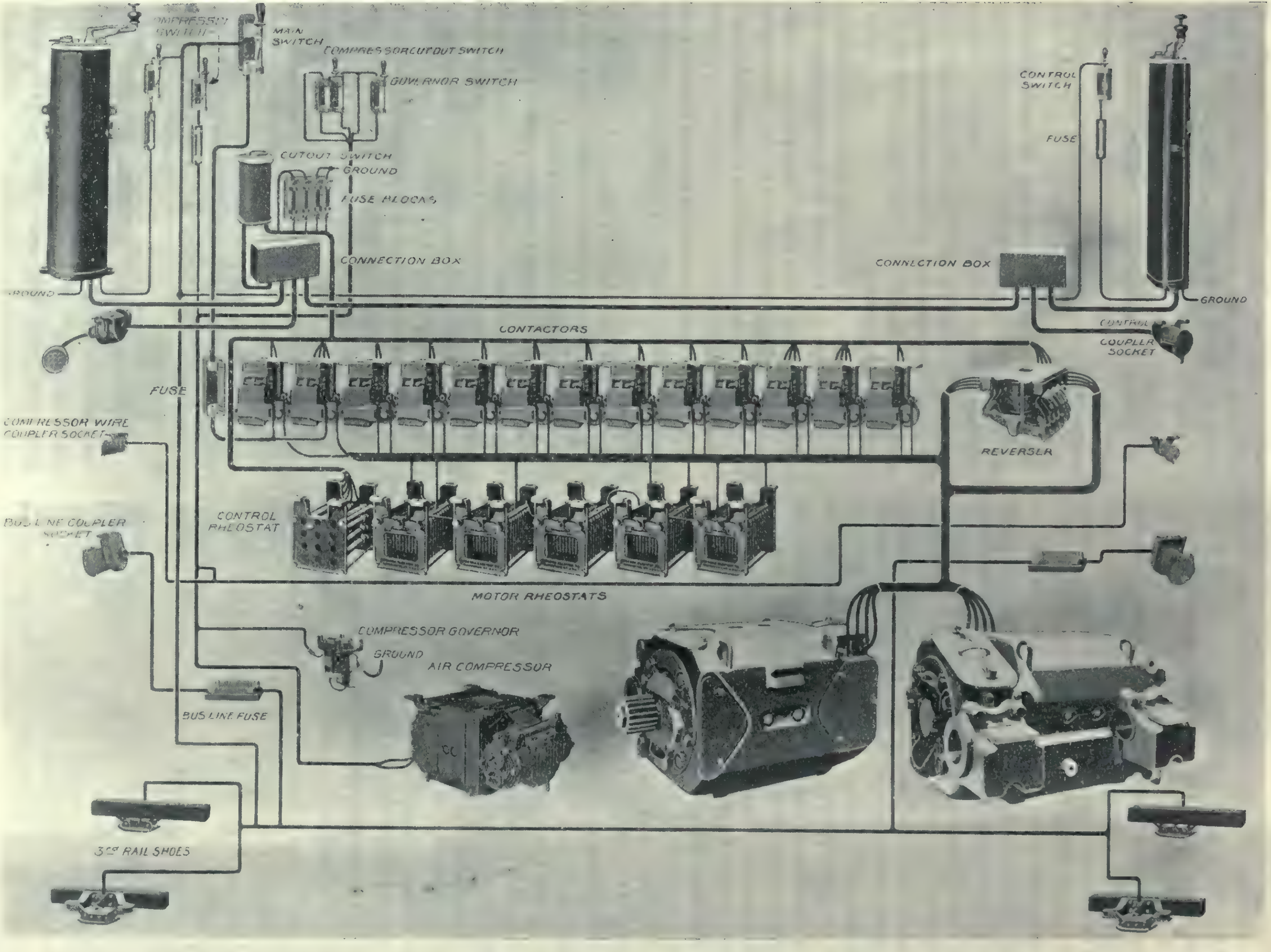
10.—Should a foreigner who has patented an article in England, be allowed to import the article, manufactured abroad, into England, unless he can prove that he has attempted to secure the manufacture on fair terms in this country?

11.—Should there be a council appointed by the Patent Office Department to determine rates of royalty, and licenses, and take into consideration the time and money risk involved in protecting an invention in order to fix the term of years to be allowed the inventor in which to secure a fair recompense?

12.—Should patent cases be tested before a special tribunal of technical and legally trained experts, instead of the Judges with little or no knowledge of practical science?

These questions have already produced some very useful expressions of opinion from which we shall make a selection in the next issue. In the meantime we shall be glad to receive further replies from readers who are specially interested.

(To be continued.)



ARRANGEMENT OF TYPE M CONTROL APPARATUS—INTERBOROUGH RAPID TRANSIT CO. (*See opposite page.*)

ELECTRICAL AFFAIRS.

(BY OUR OWN CORRESPONDENT.)

Training Motormen for the New York Subway.

In order to educate the 3,000 odd motormen and guards required for operating the trains in the new subway, New York, the Interborough Rapid Transit Company have established a special school car and a staff of expert demonstrators to teach the men. The car is completely equipped with motors, controllers, connections, air-brake system, for a complete train, and all the necessary fittings.

The wiring is attached to the roof of the car in exactly the same position as it occupies underneath, so that the motorman will know exactly where to look in case of trouble. The apparatus is specially constructed and arranged in the school car that it can be quickly opened up for examination by the students.

The figure herewith, showing the apparatus and construction of an electric car worked on the multiple control system will give some idea of how the school car is fitted up and how much the men have to learn to be thoroughly acquainted with the apparatus.

Examinations and Books.

Unlike other companies the subway officials are proceeding on the lines that it is better to teach motormen to make small repairs, as there is then less chance of a serious stoppage of traffic. The motormen are principally recruited from steam-locomotive drivers, and they already have a good grounding in mechanical knowledge, and are acquainted with the intricacies of the air-brake system. The course of teaching is arranged on a proper graduated scale with examinations written and oral, between the various stages. Copies of the regulations and books are provided for the men to study from, and the book describing the detail of the multiple unit system of control is the most complete and detailed description of that system which has yet been published.

Fireproofing of Cars and Stations.

There are two reasons why the Interborough Rapid Transit Company have gone to so much trouble and expense in the training of the men. One is that they wished to open the whole system at once, and the other that as this railway is practically the first underground line in New York, they wished to ensure that there should not be the slightest hitch to frighten away passenger traffic. The man in the street has a long memory and still recollects the accidents on the Paris subway and at the terminus of the Liverpool Overhead Railway.*

As a matter of fact, the chances of accidents on the New York underground line are about as remote as they well could be. The whole of the electrical apparatus and wiring on the underside of the car and in the motorman's cab, etc., is completely protected by a special fireproof sheeting having asbestos as its base. The wires are covered in by moulded asbestos forms, and where wood must necessarily be used as a backing it is of maple, which experience has shown to be the most non-flammable of all the commercial woods.

Not only have the cars been made fireproof, but the stations and stairways, etc., are absolutely so. The platforms are of concrete and terra-cotta, the walls of glazed brick; indeed, the writer did not see a scrap of wood anywhere in the station.

At the same time, they are very artistic and pleasing to the eye. The company have even gone to the trouble to arrange the names of the stations in coloured glazed bricks, let into the white glazed brick background.

Provision for Comfort of Motormen and Guards.

In the latest types of rolling stock for elevated electric railways in the States, provision has been made for the comfort of the motormen and guards, such provision also carrying with it other advantages. Thus, electric heaters are now provided in the motorman's cab, and, besides adding to his comfort, the additional heat is of material assistance in the satisfactory operation of the air-brake valves, for these valves have often given trouble by the lubricant becoming thick during severe weather. The end platforms and swinging gates on the Manhattan type of car, which is similar to the one used on our Tube Railway, are now being done away with, and the whole of the platform area is enclosed, sliding doors being provided wide enough for the passengers to enter two abreast. The guard stands inside the car.

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* Since the above was written the subway has been opened and has carried as many as 350,000 passengers in one day. Indeed, the pressure of traffic has been so great that it has been impossible to run to schedule time. That this large crowd has been handled without a single hitch, is a testimonial to the thoroughness with which the men on the staff have been trained in their duties.

SOUTH AFRICAN NOTES.

Electric Cable Imports.

The value of the imports of electric cable, wire, and fittings into the Transvaal during the six months ending June last is returned at £38,000, as contrasted with with £34,000 in the corresponding half of 1903.

Progress in Rhodesia.

Mr. George Mitchell, President of the Chamber of Mines in Rhodesia, at the quarterly meeting held on September 22nd, spoke optimistically of the gradual increases that have been apparent in the productions of the past few months. The first eight months of 1904 have yielded 162,507 oz. of gold, 39,979 oz. of silver, 276 tons of lead, and 38,308 tons of coal. Comparing this with a similar period in 1903, the production then was for the eight months mentioned, 160,749 oz. of gold and only a small quantity of silver, the total value for that period being £576,668, whereas the total value of mineral productions for the eight months of this year is £624,935, an increase of £48,267. If, however, the figures for the five months from April 1st are taken, the date when the Chamber's financial year commences, and when the fiscal year of the Administration also begins, the comparison is more favourable as regards the total mineral production. There is every reason to believe that this year will show a satisfactory increase in the output over last year's. July and August were record months.

The Mechanical Engineers' Association of the Witwatersrand.

In his presidential address to the members of the Mechanical Engineers' Association of the Witwatersrand, Mr. A. C. Whittome said the first object which they had in view, was to obtain from the Lieutenant-Governor of the Transvaal a Charter of Incorporation. This might at first sight appear to some an empty title, but he assured them that it was not so. They looked upon it as a "hall-mark," and believed that when it was granted it would confer a greater weight upon their proceedings, although it would, of course, increase their responsibilities.

Suggested Industrial Exhibition at Johannesburg.

The President of the Chemical, Metallurgical and Mining Society of South Africa (Mr. W. A. Caldecott), acting upon a resolution of the Council, has approached the presidents of the kindred societies in order to discuss whether it would be advisable to have an industrial exhibition in Johannesburg to synchronise with the visit of the British Association to South Africa, and a report is to be submitted in due course.

In the course of his inaugural address to the members of the Association, Mr. Caldecott made some interesting remarks on the investigation by sub-committees of the society into certain methods of industrial analysis. There was, he said, a great field in the direction of establishing recognised tests for the quality of the millions of pounds' worth of stores and supplies bought annually by mining companies in that district alone. Their colleagues, the engineers, would, he was sure, welcome methods of examination which provided them with means of testing periodically materials such as fuel, lubricants, water, and steel in various forms. Already, regular analyses and tests of coal and explosives had been carried out by one of their mining corporations, but the system generally was in its infancy, and its future extension promised much in the regions of economy and efficiency. One result would be that the mine assay office would tend to develop more into the laboratory, and that while more than a knowledge of one branch of the art would be asked of that most hard-working member of the mine staff, the assayer, yet his status would be correspondingly raised, and the monotony of his present ordinary duties greatly relieved.

Among the possibilities of future progress two things stood out. Of their total working expenditure on gold mining companies, three-fifths or more was roughly consumed in actual mining costs alone; metallurgical costs in all amounted to little more than one-quarter of the whole. Their mining members had here opportunities for economies which were denied to their less fortunate fellow workers on the surface. The other object to be sought for lay in the fact that whilst with years their metallurgical methods had improved in the directions of continually increased percentage recovery, and continually reduced working costs, yet this had been attended by equally continuous increasing of initial capital expenditure. At present their capital expenditure on existing or future deep level mines amounted to very large sums indeed, and though this was even now most amply repaid, yet to achieve their present or better results and yet lock up less capital was an object fully as desirable as any they had striven for and achieved in the past.

ENGINEERING DEVELOPMENTS.

Rotary "Drum" Pump Installations.

We illustrate by the courtesy of the Drum Engineering Company, of 27, Charles-street, Bradford, the latest application of their "Drum" pump. The pumps shown below are made of gun-metal and are now at work pumping brewer's worts in a large brewery in the Midlands. They have 4-in. suction and delivery and a capacity of 12,000 gallons per hour each pump. They are driven by a 12-in. by 12-in. vertical steam engine and connected thereto by friction clutches so that either can be worked independently of the other, or both together, as may be desired.

The "Drum" rotary piston pump differs from the ordinary rotary pump, passing the water through in one continuous flow and utilising the power in the momentum of the moving column. It consists of a revolving piston sweeping out the cylinder every revolution. The revolving piston dips into a revolving valve or cylindrical drum, the openings in which are so arranged that the piston passes through without slip, back pressure, or undue friction. When the revolving piston moves round from the revolving valve a vacuum is formed, into which the water flows and is forced in the front face of the piston.

It is particularly useful for pumping semi-fluids and can also be used as a blower and gas exhauster.

The "Drum" is simple in construction and it is claimed for it that it will work equally well in either direction.

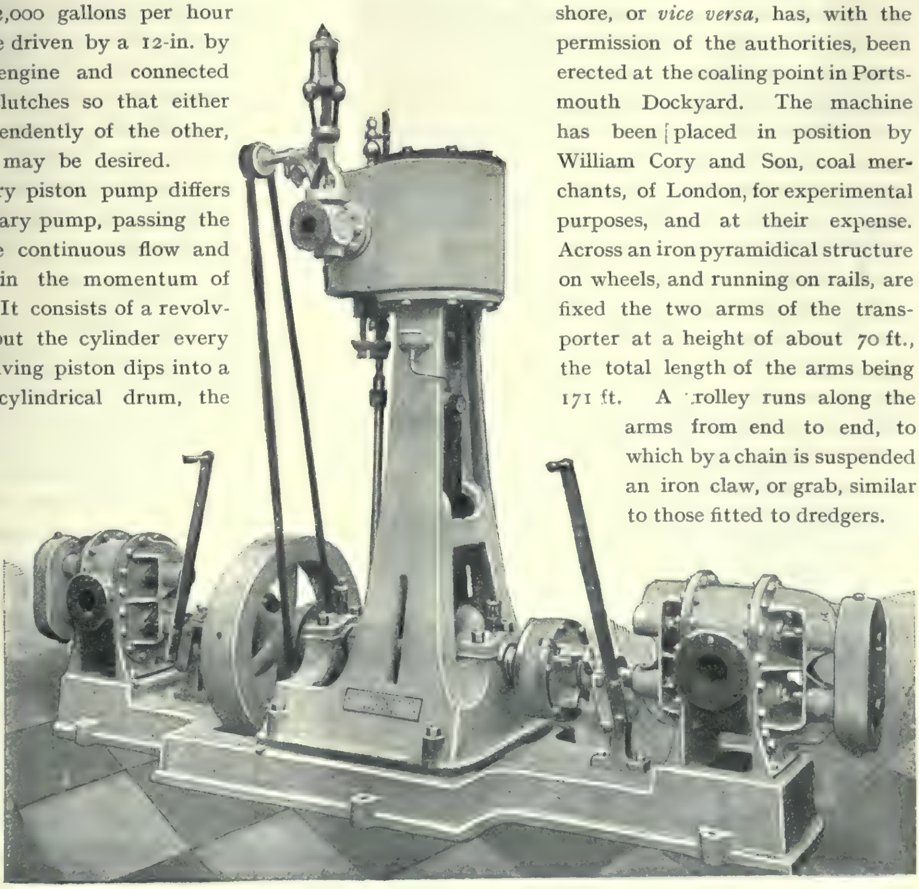


FIG. 1. "DRUM" PUMPING INSTALLATION FOR A MIDLAND BREWERY.

These pumps are connected to vertical steam engine with friction clutches, so that each may be worked separately or both together.

New Coal Transporter.

The Times Portsmouth correspondent reports that a crane transporter for lifting coal in bulk from the hold of a collier and transferring it to the stack on shore, or *vice versa*, has, with the permission of the authorities, been erected at the coaling point in Portsmouth Dockyard. The machine has been placed in position by William Cory and Son, coal merchants, of London, for experimental purposes, and at their expense. Across an iron pyramidical structure on wheels, and running on rails, are fixed the two arms of the transporter at a height of about 70 ft., the total length of the arms being 171 ft. A trolley runs along the arms from end to end, to which by a chain is suspended an iron claw, or grab, similar to those fitted to dredgers.

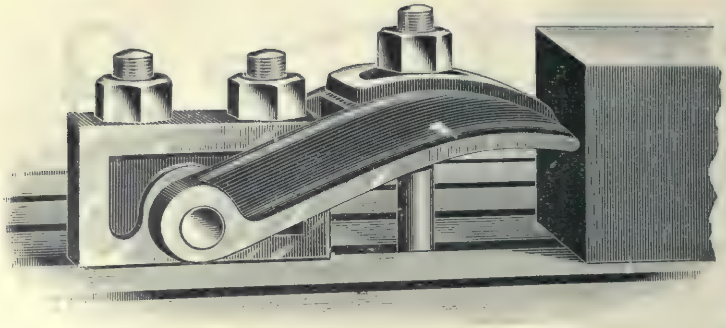


FIG. 2. COMBINATION CRAMP.

By Messrs. Edward G. Herbert, Ltd.

The arms can be triced up, but have no lateral motion. The grab, which is worked by steam, descends into the collier's hold with its claws open; these close on the coal, the grab is then hoisted and run along the transporter until over the coal stack, when it is lowered, and on striking the ground or stack the claws open, releasing their contents.

The machine is quick in its action, and requires few men to work it, but has several disadvantages: (1) the grab falls into the collier in the same place each time, thus digging a deep hole in the cargo; (2) if the coal consists of large lumps it does not easily pick it up; (3) the claws do not open until the grab strikes the stack, which is detrimental to the coal, by breaking it. It does not therefore appear that at present this transporter has any advantage over the tip buckets, worked by hydraulic cranes, which are now in use. Trials with the machine in unloading a collier, at which several Admiralty officials were present, have recently been made, and more are to follow, with the view of ascertaining whether a similar transporter would be advantageous at Portland.

In dredgers the claws open and allow the mud to fall out, and considerable improvement would follow were the coal grab similarly fitted. Sufficient trials, however, have not yet taken place to enable the practical value of the transporter to be determined.

New Drawing Office Accessory.

A unique device for drawing curves comes to hand from Mr. W. J. Brooks, scientific instrument maker, 33, Fitzroy Street, W. It consists of a narrow strip of transparent celluloid, provided with a number of tabs, by which the strip may be adjusted to any attitude or degree, and then held securely in position by the fingers. The instrument is made in several styles to suit the varied requirements of professional draughtsmen. We have submitted the specimen to a series of practical tests, and find it in every way satisfactory. From the same manufacturer we have received Brook's Parabola Curve, which is accurately cut in celluloid, and its axis, focus, and latus rectum are engraved upon it. Apart from the particular purposes for which this curve is intended, it has an obvious utility as a set curve. Both of these instruments should find a place in every drawing office.

The Motor Industry in Great Britain.

It is calculated that there are 21,000 motor-cycles and 18,000 motor-cars at present in use in Great Britain. Summing up the season's business, a contemporary remarks that only a small number of companies have probably earned satisfactory profits, while others have done less trade than before. The export trade is done chiefly with South Africa. There is some with Australia, but a good many machines are being built in the Commonwealth from English fittings. The motor trade has spread nearly all over England, and in that respect has not followed the history of the cycle industry, which for many years was practically confined to one part of the country.

Combination Cramp.

From Messrs. Edward G. Herbert, Ltd., of Manchester, we have received details of their "Combination" Cramp (fig. 2), a useful auxiliary in the machine shop for use on planing, shaping and other machines. The cramp is intended mainly for use as an end cramp, but it can be used as an ordinary cramp, when it gives four different gripping heights instead of the six given by the hexagon cramp. It can also be used in many cases as a side cramp, but this depends upon the width of the work and the pitch of the slots. When used as a side cramp only one holding-down bolt is used, and this can be put in either of the two holes. By turning the block round two more bolt hole positions are obtained. Our illustration shows this device used as an end cramp.

The Panama Canal.

The surveying and planning necessary for the Panama Canal, notwithstanding that the line already marked out by the French company will be largely followed, will occupy the remainder of the present year, and the whole of 1905. It will then take eight years to complete the work, the entire cost of which is estimated at £40,000,000.

SOUTH STACK LIGHTHOUSE, NEAR HOLYHEAD.

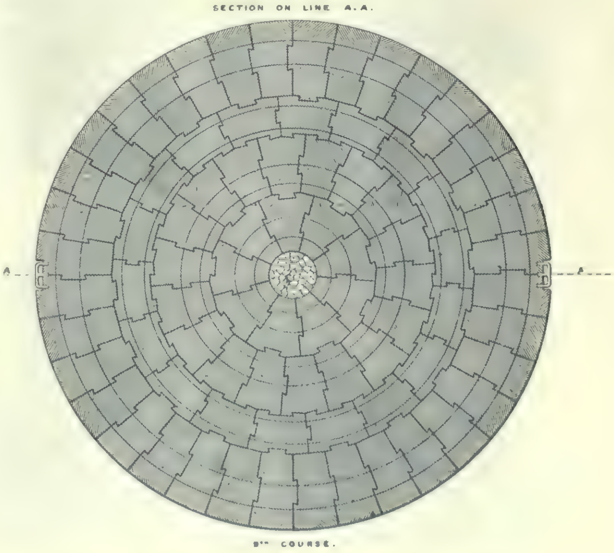
The lighthouse is approached by 700 steps, and is lighted by a Douglass oil burner.

POINTS IN LIGHTHOUSE CONSTRUCTION.

A MOST important element in the construction of a rock-lighthouse tower is the force of inertia produced by the weight of the material, and to ensure rigidity, and to prevent the loosening of any of the stone blocks, it is necessary that the structure should be monolithic. With this object in view the stones are joined together by dovetailed joints and metal bolts, so that no single stone can be moved without moving all its neighbours. A good example of this construction is shown herewith.

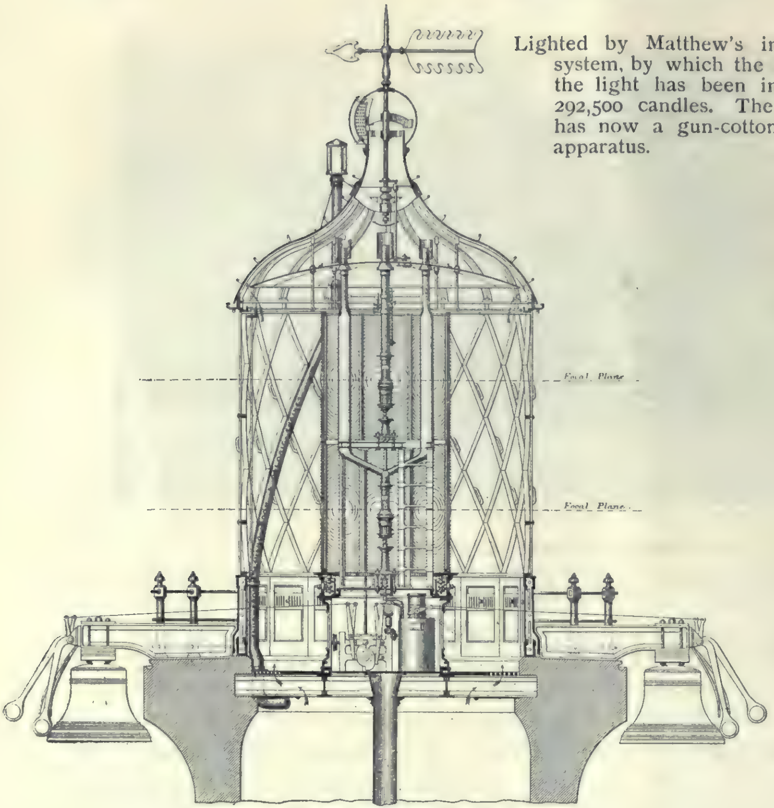
The towers of lighthouses are generally given a curved batter on the face so as to spread out more rapidly towards the base and so secure a large area at the foundations. It is well known also that the curved batter assists the upward run of the waves. In the case of the Bishop lighthouse, which is exposed to very heavy seas, the whole structure was enveloped in an outer casing of masonry, dovetailed, horizontally and vertically. The cylindrical base is 41 ft. at the Bishop Rock, and the curved batter only begins from the top of the cylindrical base. To strengthen the tower in the case of exposed lighthouses, it is carried up solid for some distance. The Bishop Rock tower is solid for 47 ft. above high water, and the Eddystone for 25½ ft.

To reach the days when the results of scientific

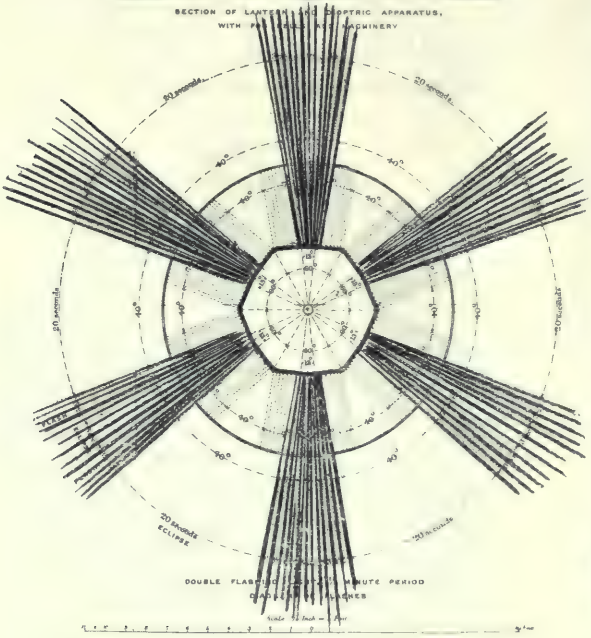


SECTION OF EIGHTH COURSE IN CYLINDRICAL BASE OF THE EDDYSTONE.

Lighted by Matthew's incandescent system, by which the intensity of the light has been increased to 292,500 candles. The lighthouse has now a gun-cotton fog-signal apparatus.



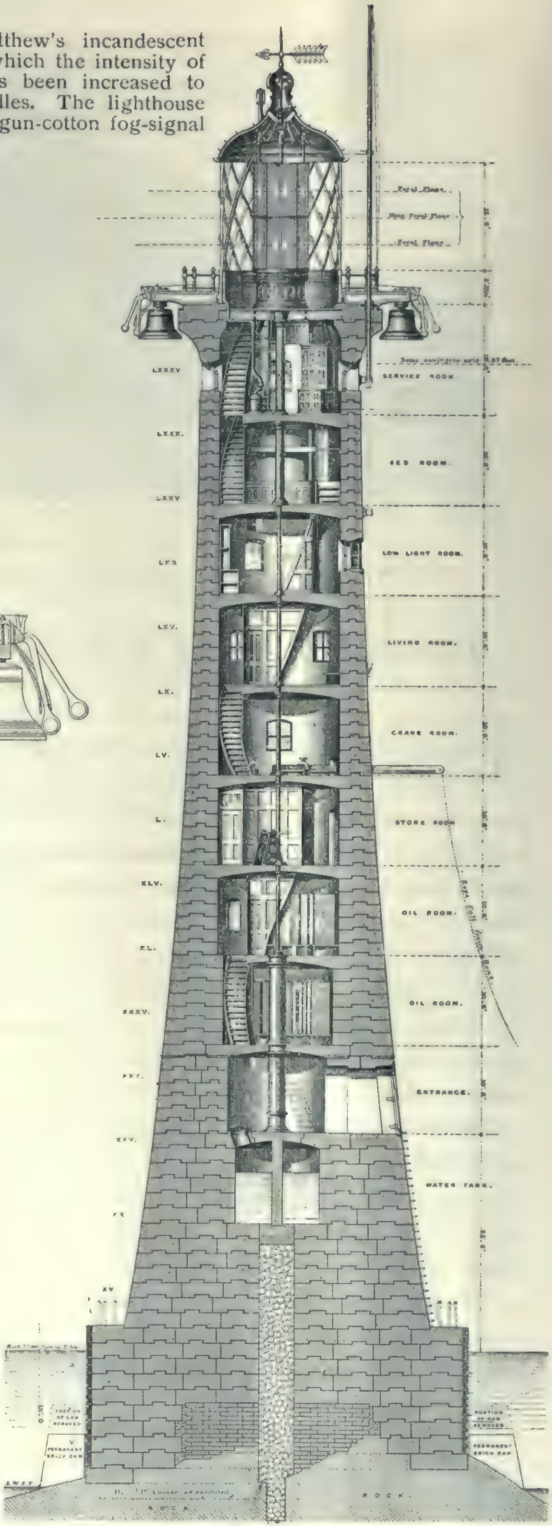
SECTION OF LANTERN AND DIOPTRIC APPARATUS, WITH [illegible] MACHINERY



DOUBLE FLASHING [illegible] MINUTE PERIOD [illegible] FLASHES

EDDYSTONE LANTERN, SHOWING THE OLD BIFORM LENS AND DOUGLASS BURNERS.

Also illustrating condensed rays of a revolving light.



SECTION OF THE EDDYSTONE.

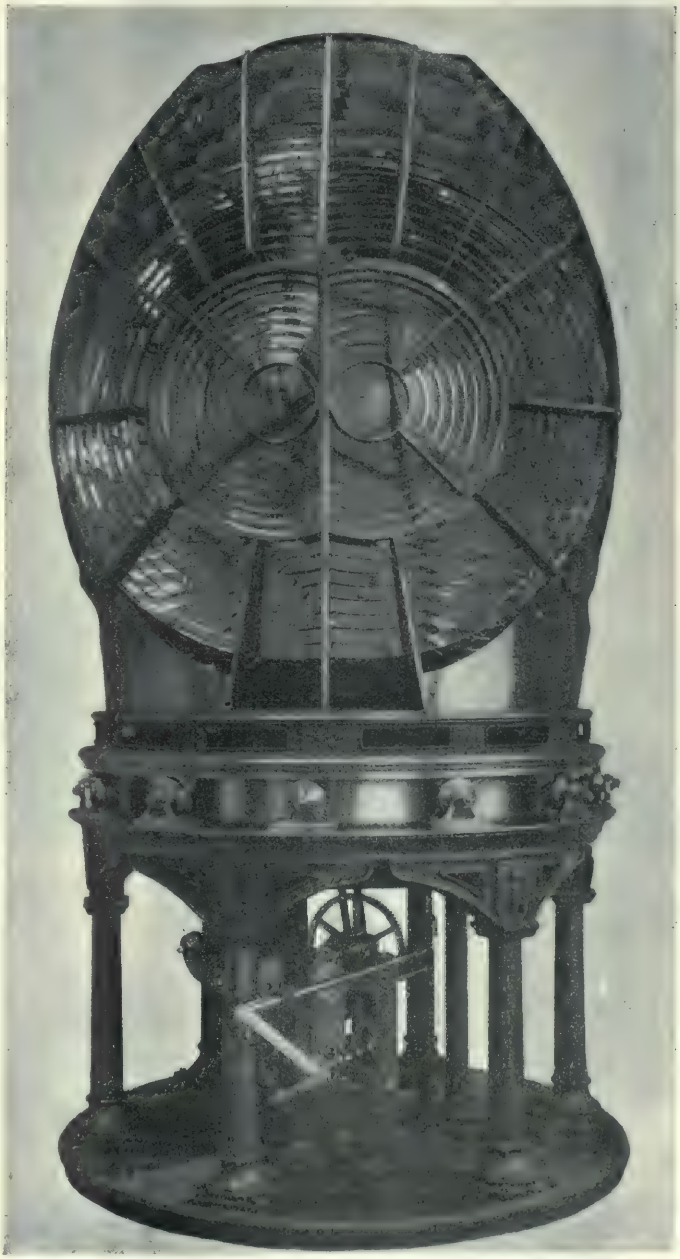
knowledge began to be utilised for the improvement of lighthouses, we must advance to the beginning of the nineteenth century. The invention of the Argand burner and the parabolic reflector enabled a very remarkable improvement to be introduced. Again, about the same period, Fresnel invented his wonderful doiptric apparatus and lamp.

The oil used for many years has either been paraffin, 150 deg., or mineral colza, 250 deg. All kinds of illuminants have been tried, and the result of experiments is to show, first, that the electric light, as exhibited in the A experimental tower at South Foreland has proved to be the most powerful light under all conditions of weather, and to have the greatest penetrative power in fog.

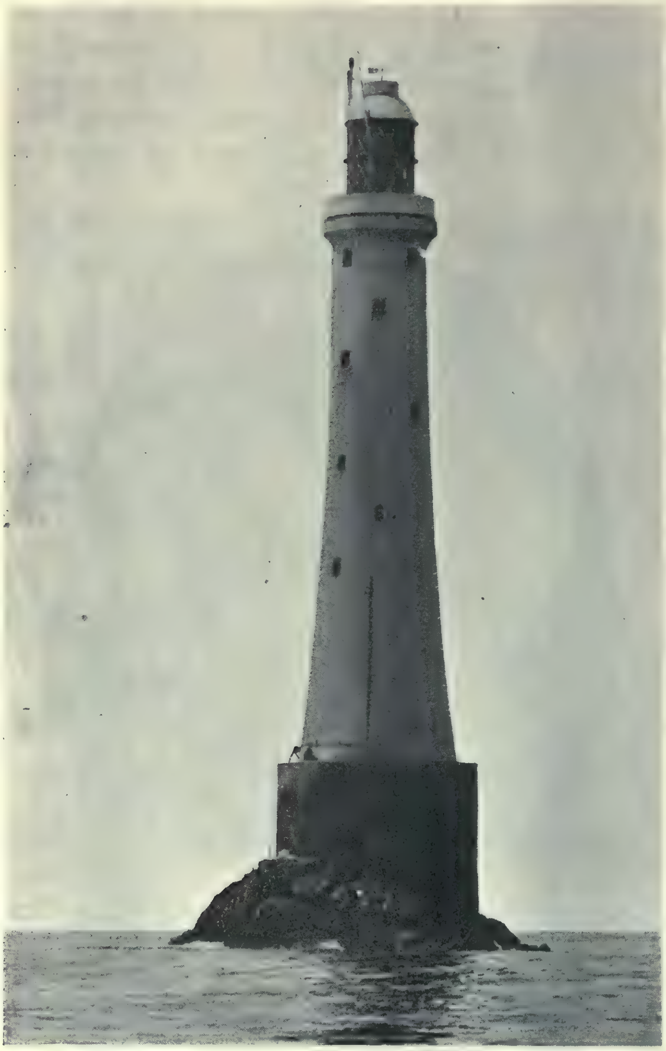
It has been demonstrated for all practical purposes that the gas light as exemplified by Mr. Wigham's multiform system in B experimental tower and the oil light as exemplified by the Trinity House Douglass 6-wick burners in multiform arrangement up to triform in C experimental tower, when shown through revolving lenses are equal, light for light, in all conditions of weather; but that quadriform gas is a little better than triform oil.

When shown through fixed lenses as arranged in the experimental towers, the superiority of the superposed gas light is unquestionable. The larger diameter of the gas flames, and the lights being much nearer to each other in the gas lantern, give the beam a more compact and intense appearance than that issuing from the more widely separated oil burners.

For the ordinary necessities of lighthouse illumination mineral oil has been shown to be the most suitable and economical illuminant, but for the more important headlands, and places where a very powerful light is



THE LATEST OPTICAL APPARATUS IN USE AT BEACHY HEAD LIGHTHOUSE.
Showing mechanism of rotating apparatus.



BISHOP ROCK LIGHTHOUSE.
Lighted by biform oil lamp, with an intensity of 292,600 c.p. It is fitted with explosive fog signal.

Illustrates the manner in which the sea rises on reaching the lighthouse.

required, electricity offers the greatest advantages.

In the accompanying pages we illustrate some of the varying forms of lighthouse construction and illumination, the figures and diagrams being largely self-explanatory.

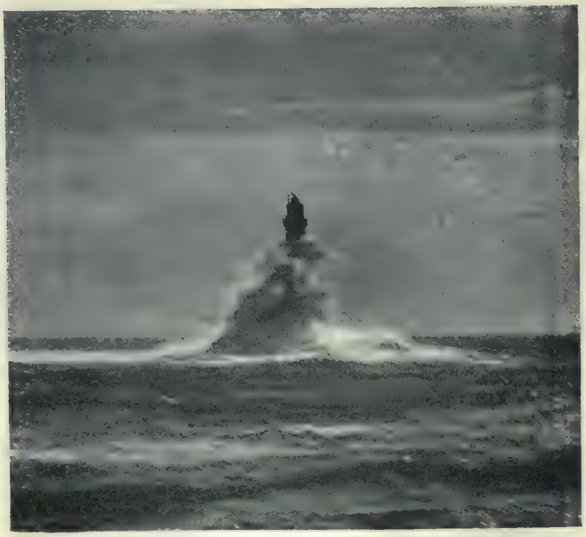
DETAILS OF CONSTRUCTION.

Rock lighthouses are mostly constructed of granite, that being the hardest available stone, while lighthouses on land are usually built of masonry or iron. For the well-known Jersey lighthouse, the Corbière, concrete in mass was employed. When the foundation (as in the case of the Eddystone) is below the level of high water, the first operation is the familiar one of building a brick cofferdam, inside which the men can do their boring and cutting for the few hours which constituted a tide's work. This mode of operation is not, however, always suitable for irregular rocks which are exposed to the open sea, and, as a general rule, the whole of the area on which a lighthouse tower has to be founded should be above low water in order that the foundation stones may be cemented to the rock. It happens, fortunately enough, as Mr. L. F. Vernon-Harcourt points out in his recent book on Civil Engineering, that rocky shoals in the sea are usually composed of the hardest strata, and afford a very firm base for a lighthouse tower.

In the case of the Eddystone, the lower part of the tower was made cylindrical, a base of this character causing the waves to break, and thus preventing the upward run above referred to.

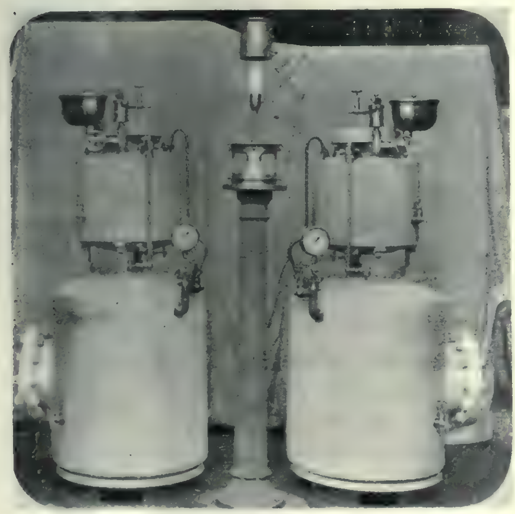
BEACHY HEAD LIGHTHOUSE.

Lighted by Matthews's incandescent system since 1892.



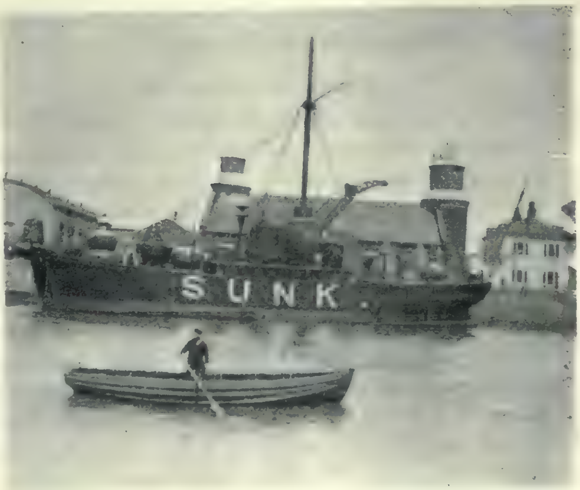
THE WOLF ROCK LIGHTHOUSE.

Illustrating sea action on base.



THE MATTHEWS INCANDESCENT OIL BURNER.

The oil is vaporised under a pressure of 53 lb., and is then fed by a pipe to the base of the burner, from which it rises to the mantle. The oil is contained in the upper vessel, the lower containing air.



THE "SUNK" LIGHTSHIP.

The vessel is undergoing repairs at Trinity Wharf, Blackwall—the most important station of the Trinity Corporation. Two expertimental lighthouses are shown in the rear.

THE PRESERVATION OF RAILWAY SLEEPERS.

IN the course of a paper prepared for the seventh session of the Railway Congress, Mr. Hausser, Chief Permanent Way Engineer of the French Midi Railway, discusses the species and kind of wood which can best be employed for sleepers and also the important question of preserving them.

It may be stated in a general way that the wood principally used by railway managements for making sleepers is that of oak, beech and different conifers. Baltic pine is used extensively in the north of Europe; it has even been used in South Africa.

Beech (*Fagus*) is very generally creosoted; sometimes it is pickled with chloride of zinc. Oak (*Quercus*) sleepers are generally cut out of heartwood; when the sleepers contain both heartwood and sapwood they are creosoted

Pine (*Pinus*) and fir (*Abies*) are usually pickled. The pickle used is either creosote, or a salt such as cupric sulphate or zinc chloride; sometimes an emulsion, consisting of creosote mixed with an aqueous solution of a salt, is used.

Special sleepers are generally made of hard wood, and oak is distinctly preferred. Beech, pine, and fir are only used for special sleepers to a limited extent. Whatever kind of wood is used, it is pickled, except in the case of heart of oak. The wood used for sleepers may be either soft wood or hard wood.

METHODS OF PICKLING.

The necessity of giving the sleepers a long life is universally recognised, and it is for this reason that pickling is very generally adopted. The pickling methods adopted by the different railways tend to show that in the case of oak (except in the case of sleepers made of heartwood only, which are not pickled) the best antiseptic is creosote. The two essential constituents which have to be present in creosote are naphthaline and carbolic acid. Generally speaking, more importance, from the antiseptic point of view, is attached to the carbolic acid than to the naphthaline; the effect of the latter is rather a disputed point. On the average at least 5 per cent. of carbolic acid must be present, and there must not be more than from 25 to 30 per cent. of naphthaline.

Among the managements which use chiefly soft wood (pine or fir) sleepers, the two pickles which are more generally used are cupric sulphate and zinc chloride. A mixture of creosote and zinc chloride is also used, but not so extensively. It has been tried on the State railways, in Austria-Hungary, Denmark, and France and on the St. Gothard Railway (Switzerland), but the information supplied does not yet make it possible to draw definite conclusions as to the merits or otherwise of this mixture. Finally, creosote is also used for pine and firwood, although in some cases it has proved to be less effective than cupric sulphate. Thus it was found, on the French Midi Railway, that the heartwood of the cluster or maritime pine (*Pinus Pinaster*) decomposed more quickly if creosoted than if pickled with cupric sulphate. The creosoted heartwood appeared subject to a quick dry rot which spreads in such a way that the heartwood decays away from the sapwood. In this way a sort of heart shake is formed, and the heartwood, which has decayed by a kind of dry rot, separates from the perfectly sound and good pickled sapwood. As sleepers pickled with cupric sulphate do not show this peculiarity, the French Midi Railway has given up creosoting pine sleepers, and now treats them with cupric sulphate.

In his conclusion, the author says:—

1. It is possible to use both hard woods and soft woods. The selection depends on individual conditions.

2. It is advisable to have strict specifications and to exercise great care when receiving sleepers. The timber yards where the sleepers are prepared must be kept clean and free from decaying matter; sleepers after cutting up must be stacked above the ground so as to allow free access of air, light, and warmth.

3. The pickling of sleepers in order to increase their life is to be generally recommended. The selection of the antiseptic and the method of carrying out the pickling depend on individual conditions.

4. Not covering up the sleepers does not reduce their life. If they are not covered up, it is possible to see any defect at once and if necessary remedy it immediately.

5. It is of the greatest importance to combine great strictness when aceepting sleepers with great care in selecting the ballast; the latter must be permeable, must be capable of being well-packed and the packing well maintained, and give good adhesion between the sleeper and its seat. The measures which are best for the preservation of the wood are also best for the stiffness of the track.

6. In order to prevent any contamination of the ballast, and at the same time help to preserve the sleepers, one cannot recommend too highly the careful drainage of the roadbed, in order to ensure that any water may run off properly.

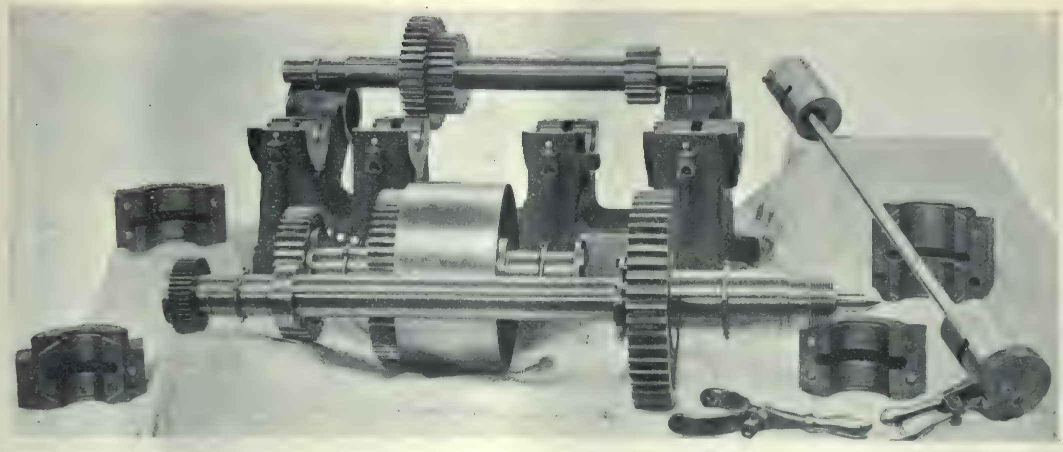


FIG. 1. LODGE AND SHIPLEY'S NEW PATENT LATHE HEADSTOCK SHOWING THE PARTS IN DETAIL.
The back-gear shaft is solid, and runs in eccentric journal bushes, which are also self-oiling by means of bucket rings, the same as on the main spindle and pulley shaft bearings.

THE LODGE AND SHIPLEY NEW LATHE HEAD.

THIS lathe head (fig. 2), which has just been introduced into Great Britain, is a great advance on previous attempts to deal with the troubles arising from running the cone pulley on the lathe spindle itself. Lathe users will at once appreciate the abolition of defects such as inaccessibility of oiling arrangements for the bearing of the driving cone and the necessity of stopping the lathe when oiling is required. The bosses of the cone pulleys are often short and out of centre with part of the pulley, so that the belt stress comes on a part of the cone not directly supported on the spindle, and where this is the case the hole in the cone is soon worn "bell-mouthed," and a constant vibration and chattering is set up which reproduces itself upon the work, adding greatly to the difficulty of securing fine finish or accuracy. These defects have been entirely obviated by the new construction.

Fig. 3 shows the patent head in position on the lathe, with the caps of the bearings removed. A single driving pulley of full width replaces the driving cone, and this pulley is carried on a hollow shaft which runs in two bearings in line and concentric with the spindle bearings proper, but as the pulley shaft is hollow and has a 1–16th clearance all round the main spindle, it is entirely supported by its own bearings, and there is an entire absence of belt stress on the lathe spindle itself, the only contact between the driving pulley shaft and the spindle being at the claw clutch which is to be more clearly seen in fig. 2, and the examination of which will show the hollow shaft with the claw-teeth on the front end. Connection is made with the clutches when the lathe is required to run ungeared. When running geared the claw-teeth are, of course, out of contact, and the motion is transmitted through the back-gear shaft on to the large face wheel which drives the spindle. This face wheel is keyed solidly to the spindle, but on its inner boss is a sliding clutch which is operated by a hand lever. On the pulley shaft are keyed two gears of different diameters, either of which can be used

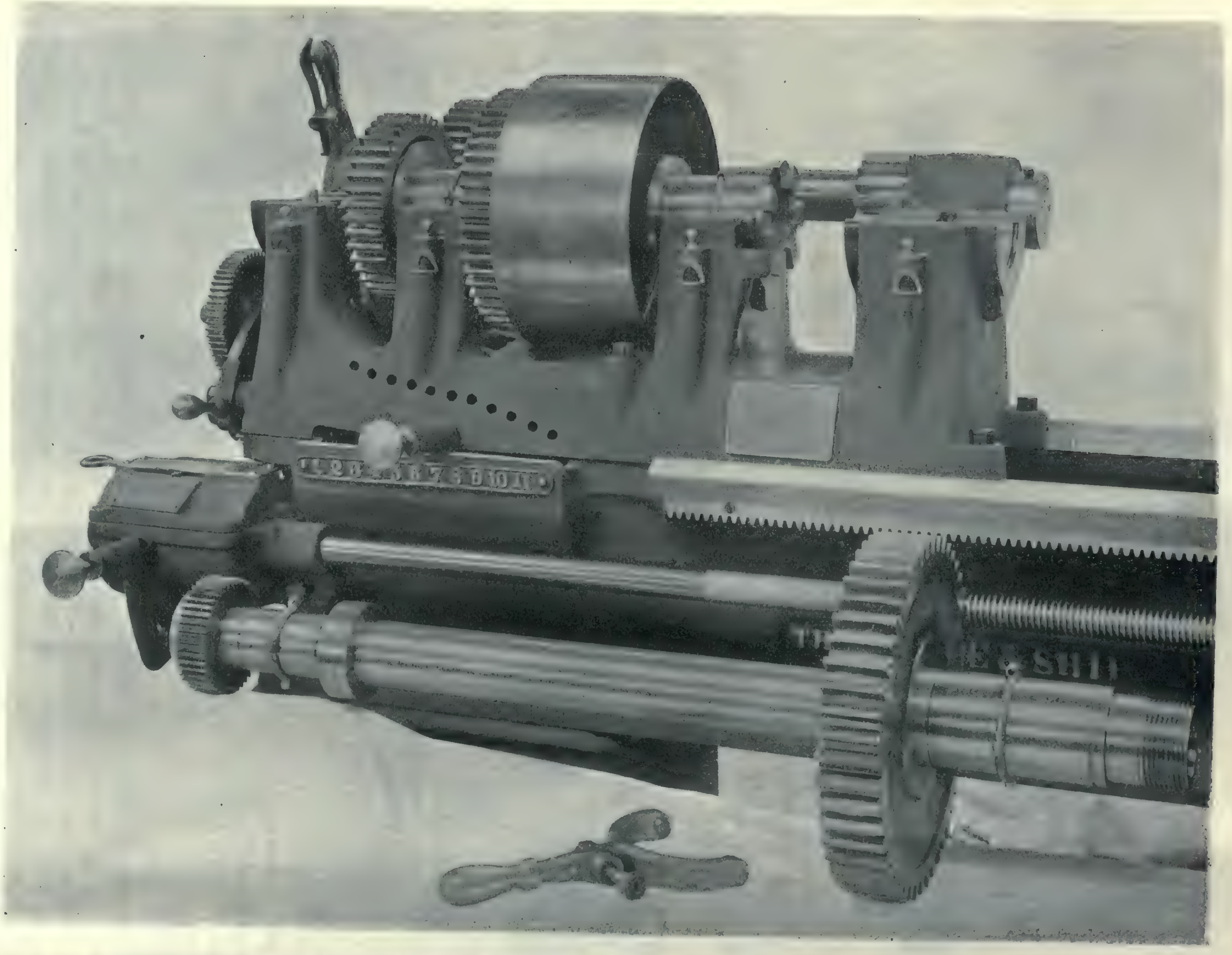


FIG. 2.—ANOTHER VIEW OF THE NEW PATENT LATHE HEADSTOCK.

This shows main spindle removed, leaving the hollow driving-pulley shaft in position. The claw clutch on the latter is the only direct connection between the pulley shaft and the spindle, thus the latter is relieved of all belt stress, this being taken by the two centre bearings of the pulley shaft. The hole in pulley shaft is $\frac{1}{8}$ inch larger than the diameter of the spindle.

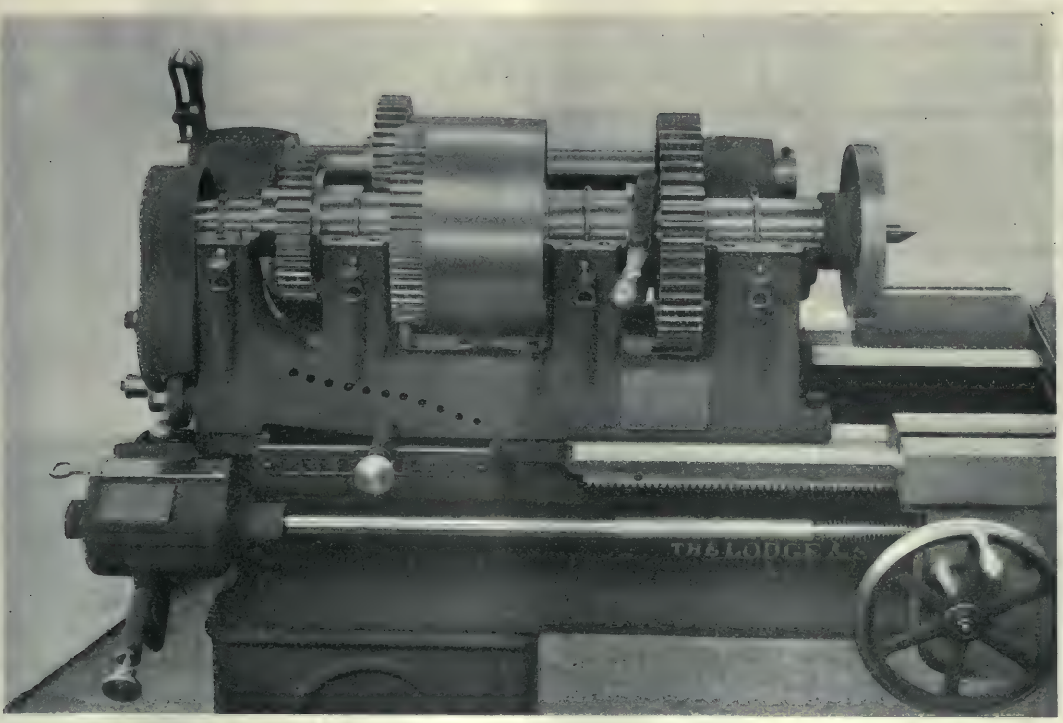


FIG. 3.—LODGE AND SHIPLEY'S NEW PATENT LATHE HEADSTOCK.

Showing bearing caps removed, otherwise all parts are in position. The bucket oiling rings ensure thorough lubrication of the bearings irrespective of the speed at which they run.

9 SPEEDS BACKWARD. SPINDLE SPEEDS FOR L. & S. PATENT HEADS, WITH TWO BELTED COUNTERSHAFT. 9 SPEEDS FORWARD.

Lathe.	Direct.			1st Back Gear.			2nd Back Gear.			1st B.G. Ratio	2nd B.G. Ratio	Counter Shaft Speed.		Size Counter Shaft.
												Forwr d	Reverse	
In.														
14	395	275	187·5	130	90·4	61·6	41·2	28·6	19·5	3 04-1	9 6-1	250	300	·1
16	409	270	187·5	134	86·4	60	45	29	20	3·12-1	9·3-1	250	300	·1
18	372	254	174	116	79	54	36·4	24·8	17	3·12-1	9·3-1	250	300	·2
20	372	254	174	116	79	54	36·4	24·8	17	3·12-1	9·3-1	250	300	·2
22	368	239	152	106	69	44	33	21·4	13·6	3·46-1	11·12-1	250	300	·3
24	414	268	174	112	72·5	47	31·8	20 6	13·3	3·69-1	13-1	250	300	·3
27	394	255	166	105	68	44·2	28 6	18·45	12	3·74-1	13·9-1	250	300	·3
30	300	188	120	77	48	31	20	12·5	8	3·9-1	15·1-1	250	300	·4
36	270	169	108	68	42·5	27·2	17·4	10·9	7	3·98-1	15·5-1	250	300	·4

SPINDLE SPEEDS FOR L. & S. PATENT HEADS, WITH THREE BELTED COUNTERSHAFT. 18 FORWARD SPEEDS.

Lathe.	Direct.						1st Back Gear.						2nd Back Gear.						Speed of Coun'r.	
In.																				
14	395	324	275	225	187	154	130	106	90·4	74	61·6	53	41·2	33·7	28·6	23·4	19·5	16·2	250	205
16	409	335	270	221	187	154	134	107	87·3	70·8	60·4	49·3	40·9	36	29	23·7	20·1	16·5	250	205
18	372	304	254	209	174	142	116	97·4	79	67	54	45·5	36·4	31	24·8	21·3	17	14·5	250	205
20	372	304	254	209	174	142	116	97·4	79	67	54	45·5	36·4	31	24·8	21·3	17	14·5	250	205
22	368	300	239	196	152	126	106	86·5	69	56·5	44	36·3	33	27	21·4	17·6	13·6	11·3	250	205
24	414	340	268	220	174	143	112	92	72·5	21·6	47	38·7	31·8	26·1	20·6	16·9	13·3	11	250	205
27	394	323	255	209	165	136	105	86·2	68	55·8	44	36·3	28·6	23·2	18·4	15	12	9·8	250	205
30	300	240	188	150	120	96		61	48	38	31	24·6	20	16	12	10	8	6·4	250	200
36	270	216	169	135	108	86·5		54·2	42·5	33·9	27·2	21·7	17·4	13·9	10·9	8·7	7	5·57	250	200

according to the speed required, which gear into two gears on the back shaft. The ratio of these gears is 3 and 9 to 1 respectively. Further changes are provided for on the countershaft, which, when equipped with two forward pulleys and one backward pulley, gives a total of eighteen speed changes forward and nine changes backward. In the ordinary way, however, the lathe is sent out arranged for nine speeds in each direction. It will thus be seen that the driving pulley is very much better supported than the old pattern, the bearings of the pulley shaft being well outside the greatest width of the pulley, and the wear of these bearings or of the spindle proper can each be separately adjusted as required. In practice it is found that the spindle keeps its alignment very much longer owing to the absence of belt stress.

The back-gear shaft is solid, and also runs in bearings which are self-oiling. The method of throwing this shaft in and out of gear will be readily seen from the detailed photo shown in fig. 1.

All the bearings are constructed on the self-oiling principle, but greatly improved in detail, so that they will run for several months with one oiling, and escape of oil is an impossibility. Deep oil wells are cast in the centre of each bearing of the spindle and pulley shaft which hold at least a pint of oil each. On the front of the headstock at each bearing is a lug communicating with the oil-well which contains a sight-glass in which the oil level is plainly to be seen. The means by which the oil is fed to the bearing is on the principle of the bucket pump and consists of a brass cast ring having projection or cups on its periphery which dip in the oil and discharge on passing over the top of the spindle, which is thus kept flooded with oil regardless of the speed at which it may be running. This construction does not in any way interfere with any of the other functions of the lathe, which are capable of all the usual movements, and retain all the well-known features of the Lodge and Shipley machines.

These lathes are handled in Great Britain by Messrs. C. W. Burton, Griffiths and Co., to whom we are indebted for the accompanying illustrations and tables, the latter showing the spindle speeds of the new patent lathe head.

The University of Liverpool.

FACULTY OF ENGINEERING.

THE council has just appointed J. H. Grindley, D.Sc., Wh.Sc., as lecturer in engineering. Dr. Grindley had a workshop experience extending over four years before commencing to study under Professor Osborne Reynolds for the degree of B.Sc., with honours in engineering in the Victoria University. After graduating with first-class honours, he was elected to a University Fellowship, and later a 1851 Exhibition Scholarship for his researches in steam, published in the Proceedings of the Royal Society; he was awarded the degree of Doctor of Science in 1902. After three years as demonstrator at Owens College, Dr. Grindley spent a further three years as head of the engineering department at the Huddersfield Technical College, which post he resigned on his appointment to Liverpool. Dr. Grindley will take as his work at the University the important subject of heat engines.

Mr. A. Leitch, B.Sc., Assoc. M.Inst.C.E., has been appointed assistant lecturer in engineering, and will devote himself under Professor Hele-Shaw, to the subject of surveying, including earthwork and masonry. Mr. Leitch served with Messrs. Kyle, Dennison, and Freer, civil engineers and surveyors, Glasgow, from 1892-97. He graduated B.Sc. in engineering subjects at the Glasgow University after a course extending over three years, 1897-1900. He was elected a student of the Institution of Civil Engineers in 1901, and served as assistant engineer to Messrs. R. M'Alpine and Sons, contractors, from 1900 to the end of 1903, when he was appointed to assist the engineering staff during Professor Hele-Shaw's absence in South Africa, He is now re-appointed, owing to the resignation of Mr. J. F. Gill, M.Sc., B.Eng.

The Faculty have also appointed Mr. G. E. Piper. A.R.C.Sc., as demonstrator in Applied Mechanics and Engineering Design and Drawing.

THE TELEPHONE QUESTION.

THIS week I reproduce a number of letters from correspondents who, from one cause or another, have asked that their names may be suppressed.

The questions referred to by number in this correspondence were as follows :—

(1) Are you satisfied with the telephone services in London

(2) In what direction is improvement desirable ?

(3) How do you consider such improvements can best be brought about ?

Further replies are to hand as follows :—

(1) Most unsatisfactory. (2) More certainty in being able to obtain calls in a reasonable time. Considerable reduction in the price, which is most excessive. (3) By doing away with the monopoly and having it handled by the L.C.C. Trunk lines being held by Government.

" We would say that we consider the London service as at present handled by the National Telephone Company, to be abominable, and we are thoroughly dissatisfied with same. As to in which direction it can be improved, there is little doubt in our minds that the destruction of a monopoly ought to effect the necessary improvement, and it would seem that the Post Office scheme, if it can ultimately be arranged, would be beneficial to subscribers."

(1) Persons desiring to telephone us are continually told " they are busy " when our telephone is in no way employed. The only possible explanation we can make of this is that there is no trunk line available, and we contend that such an answer is essentially misleading and unworthy of the companies who claim the position of monopolising the telephone system. (2) There is much more delay in making connections than in services of other large cities with which the writer is familiar. (3) When a number is called, the operator frequently mutters something unintelligible, and breaks the circuit without making clear what the difficulty is. (4) We have great difficulty in obtaining trunk line calls. We consider that the attitude and training of the National Telephone Company during the years when they had exclusive rights is largely responsible for their present inefficiency, and we fear that similar results will follow unless the telephone life in future is freed from the red-tape which surrounds it. We consider the best remedy would be in a certain amount of decentralisation and in placing more responsibility on the district managers for the improvement of their service, especially in the way of securing a healthy rivalry.

(1) We are far from satisfied with the telephone service in London, and think it a disgrace to the nation. (2) Improvement, we think, can only take place when the telephones are controlled by one controlling body, in which the general public or ratepayers have at least some voice. (3) This is rather a difficult question to deal with, as the Telephone Company would have to be got rid of ; possibly bought out. They naturally spend as little as possible, and there is no doubt that the present system of suspending telephone wires from the tops of the houses is a most unsatisfactory one, as the leakage must be considerable, more especially in London where the soot deposits on every exposed part, and must cause a great deal of leakage from one point to another.

We consider the service very unsatisfactory. The time taken to get calls through is entirely too long, and there appears to be an insufficiency of trunk lines between the various exchanges. The charges, in comparison with other places, are, we believe, very heavy.

POSTMASTER-GENERAL'S REPORT.

The recently issued report of the Postmaster-General states that—

The number of telephones in connection with the Post Office London telephone system increased during the year from 9,122 to 15,632 ; and additional subscribers are being connected at the rate of from 100 to 200 a week. Three new exchanges have been opened during the year. The accommodation at the central exchange will be nearly exhausted in the course of the financial year 1904-5 ; and the construction of a second exchange with a maximum capacity of 18,000 lines is in progress. The working of the trunk system has been materially improved by the modifications introduced in the new switchboard. The length of the underground pipes laid in the London area on March 31st last was 1,146 miles, and cables containing 125,717 miles of wire have been provided, including 32,248 miles provided for the use of the National Telephone Company on rental terms.

MR. HENRY DAVEY, M.Inst.C.E., F.G.S.,

Member of the Council of the Institution of Mechanical Engineers.

MR. HENRY DAVEY, a son of Jonathan and Mary Davey, is a Devonian, having been born in 1843 at Lewtrenchard, in Devonshire. He was educated at Tavistock, and at the age of seventeen entered as a pupil the works of Messrs. Nicholls, Matthews, and Co., who were then a well-known firm of builders of Cornish pumping engines and mining machinery.

At the age of twenty-one Mr. Davey left Tavistock, and shortly afterwards settled in London, where he occupied himself in designing machinery and contributing scientific articles to the technical press. He invented a parabolic steam-engine governor, and obtained patents for economising water and power in hydraulic cranes and hoists. The hydraulic machinery at Milford Haven was designed and erected by Mr. Davey.

In 1871 he secured his first patent for the differential pumping engine, which met with an immediate and lasting success. A year later, in conjunction with his partners, he acquired the business of Messrs. Carrett, Marshall, and Co., hydraulic engineers, Leeds; here he set up a manufactory for constructing his differential engine. At that time the direct-acting pumping engine was in its infancy, and low pressure steam was general. Sixty pounds boiler pressure was considered high enough for anything, and 45 lb. was the usual pressure in mines. Mr. Davey at once commenced making compound engines and advocating higher steam pressures. He completely altered the design of mining engines and pitwork, adapting the engines to higher steam pressures and the pump-work to higher lifts. The ordinary pit pumps were only used for lifts of 200 ft. Mr. Davey put up at Staveley one of his improved differential engines and spear-rod pumps, raising the water 720 ft. in one lift. The plungers were 20 in. diameter by 10 ft. stroke. About the year 1876 he erected at Clay Cross a pair of his engines underground, forcing the water 1,000 ft. in one lift, and about the same time erected his first large compound differential engine at Harrington Colliery, Fence Houses. The horizontal compound engine with quadrants and improved pit-work soon became greatly in demand, and as early as twenty years ago engines having 90 in. cylinders by 10 ft. stroke were made. It was contended that such large cylinders in a horizontal position would wear out in a short time. The pistons, however, were designed to prevent it by providing very large bearing surfaces, with the result that after twenty years of constant work the cylinders do not require reboring.

Mr. Davey also patented hydraulic pumping engines for mines, which became an important branch of manufacture in the Leeds works. At the Inventions Exhibition in 1885 Mr. Davey took three gold medals, one, the Howard medal, a special distinction, awarded by the Society of Arts.

In the development of waterworks plant for town water supply Mr. Davey has done much. His two-hole system of wells and his application to them of his varying lever engine has been largely adopted. He established on a scientific basis the design and construction of direct-acting pumping engines.

For the last sixteen years Mr. Davey has practised as consulting engineer in London, holding many appointments, such as consulting engineer to the Birmingham Waterworks and the South Staffordshire Mines Drainage. He has had considerable practice in arbitration and reporting on engineering schemes. He is also chariman of the firm of Hathorn, Davey, and Co., Ltd., Leeds. Among his recent designs of pumping engines for mines is his compound Cornish engine. He has shown that the old Cornish engine is limited by the principles of its construction to 45 lb. steam and four expansions, but that under such conditions it does a higher duty than any other engine working with the same pressure and the same number of expansions. By compounding the pressures and expansions and consequent economy may be increased.

Mr. Davey's patents are very numerous, some of his recent ones relating to gas engines, steam turbines, and marine engines. He is the author of a text-book on the principles and construction of pumping machinery, and of a number of papers contributed to the Transactions of several technical societies. He was awarded the Watt Gold Medal and the Telford premium by the Institution of Civil Engineers.

Mr. Henry Davey is a member of the council of the Institution of Mechanical Engineers; member of the general committee of the British Association; and also a member of the Institution of Civil Engineers.

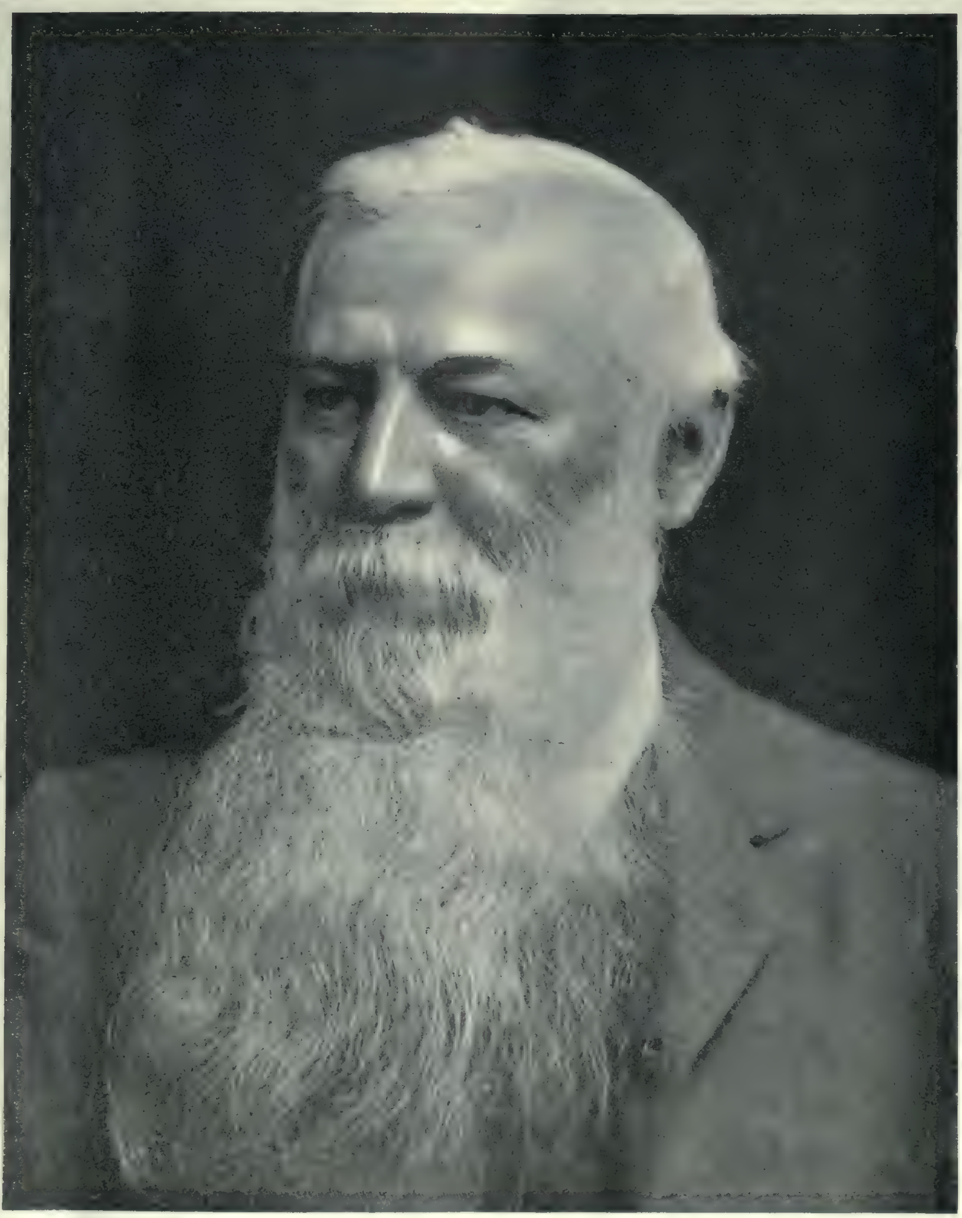
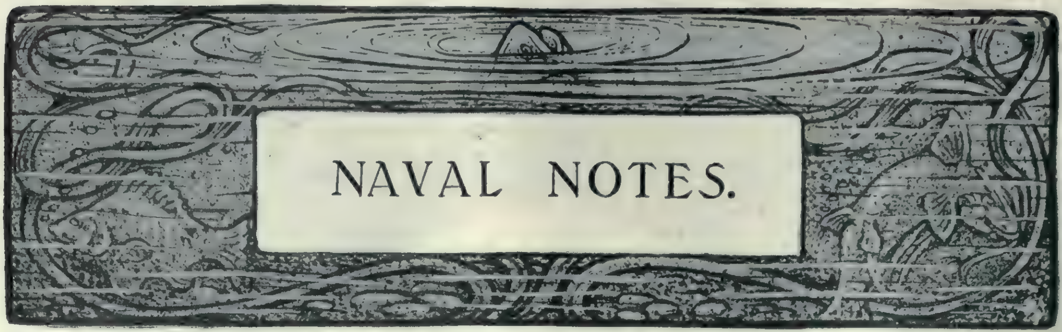


Photo by Elliott and Fry.]

MR. HENRY DAVEY, M.INST.C.E., F.G.S.



NAVAL NOTES.

WEEKLY NOTES ON NAVAL PROGRESS IN CONSTRUCTION AND ARMAMENT.

(BY OUR NAVAL CORRESPONDENT.)

GREAT BRITAIN.

THE enormous possibilities of the naval situation at the time this paper was published last week, have not, fortunately, developed. The question of the outrage by the Baltic Fleet was dealt with last week in the editorial notes; it is solely with the naval aspect of the situation that I am concerned here, and it must be said that that aspect was most satisfactory. Looking at the matter from the strategical point of view, nothing could have been better than the disposition of our three great fleets. The Mediterranean fleet was in the middle of its station, and ready to divide, part going to the Levant in case of necessity, part going west to reinforce Lord Charles Beresford, who was at Gibraltar with the Channel fleet. The Home fleet was on the east coast of the United Kingdom, ready either to repel any attack from the other side of the North Sea, or to close down in the wake of the Baltic fleet, and shepherd it gently in the direction of Gibraltar.

And the mobilisation of the reserve ships in the dockyards was carried out expeditiously, the whole of the ships out of commission being prepared for the pennant, coaled, provisioned, and with crews appointed to them, by Saturday morning. The cost of this mobilisation is, of course, great, but the lesson it has taught would be cheap at any price, and it is certainly more advantageous for us to demonstrate our absolute preparedness for war while the eyes of the world are upon us, than to expend the money on similar manœuvres under ordinary conditions of peace.

And it is satisfactory to learn, as we did learn last week from Mr. A. H. Lee, Civil Lord of the Admiralty, that there is no reduction in the strength of the Navy contemplated. This remark was, of course, a reply to the statement that has appeared in the Press to the effect that the Government proposed to abandon two of the armoured cruisers allowed for in this year's shipbuilding programme.

Of the armoured cruisers under construction at Pembroke, some interesting facts have come to light this week. According to present arrangements, the the *Duke of Edinburgh* is to be completed by this time next year, the *Warrior* is to be off the stocks in the course of the coming summer, and a third is to be commenced. To do this, will require all the energies of the dockyard staff, and now it is rumoured that the fourth armoured cruiser of this year's programme is to be built at Pembroke, as well as the first. If this be the case, the completion of the *Duke of Edinburgh* will have to be postponed six months, and the *Warrior* will not be launched until October of next year. It seems, however, unlikely that Pembroke will get two of the *Minotaurs* to build, as, early in December, the slip at present occupied by the *Britannia*, at Portsmouth, will be vacant. The engines for one of these new cruisers are to be built by Messrs. Harland and Wolff, but it is not yet stated which.

The new third-class cruiser, *Amethyst*, has been reported as completed at Elswick, and is to commence her delivery trials immediately. She is designed for 21·75 knots, and her turbine machinery has been supplied by the Parsons Company.

The destroyer *Ure*, building by Palmers, was launched on the 25th ult., being the first of the two new boats under construction at Jarrow, to take the water.

The first submarine of the new B class, 150 ft. in length, was launched on the 25th ult. at Barrow.

This vessel, which the Naval Pocket Book incorrectly describes as A 5, instead of B 1, is to have a surface speed of about 17 knots.

FRANCE.

Another vessel of the *République* class has been launched, the *Justice*, taking the water at La Seyne on October 27th. This leaves only the *Democratie* at Brest, and the *Liberté* at St. Nazaire, on the stocks. The nameship of the class was launched as long ago as September, 1902.

The only other news from France during the week has been the launch of the *Alose*, submarine, which was built at Mourillon. She is the last of a series of ten boats, built for the *defense mobile* of Corsica, Algeria, and Tunis.

ITALY.

The report that sixteen large destroyers have been ordered by the Italian Government from the Schichan firm at Elbing, seems slightly incorrect. As mentioned in these notes last week, the estimates for the present year only allow for one new battleship, fourteen torpedo-boats, and four submarines. And yet the German built destroyers are fully described by a "Globe" correspondent at Berlin, and it is stated that the speed of the new vessels is to be reduced in order to give the vessels greater seaworthiness.

RUSSIA.

To estimate the number of torpedo-boat destroyers at present under construction for the Russian Government would be an almost hopeless task. For each week brings news of the commencement of a new batch, and this week no fewer than seventeen more are reported to be building or about to be laid down. Of these, six are at the Lange Works, Riga, and for the purposes of their construction two hundred workmen from the Vulkan Yard, Stettin, have been lent to the Lange Company, and the German yard is moreover supplying a large quantity of the machinery and tools required in the building of the destroyers.

Although an effort was made some fifteen months ago to have all war vessels for the Russian navy built exclusively in Russian yards, we hear now that contracts for eleven destroyers have recently been sent to France. Four are to be built by the Forges et Chantiers de la Seyne, four by the Granville Company, and three by Normand. These seventeen added to the twenty-four mentioned in last week's notes, makes a total of forty-one destroyers under construction. At this time last year Russia possessed only fifty of these vessels, and presumably the large orders which are now being given are the outcome of experience in the Far East.

UNITED STATES.

The next Naval Appropriation Bill promises to be of exceptional interest. There are reports from Washington that the new shipbuilding programme is to comprise four battleships of 16,000 tons each, and possibly one 18,000 tons. These monster vessels are to carry four 12-in. pieces, and eight 10-in., and nothing else, except Maxims and three-pounders. When, some months ago, the Chairman of the Committee on Naval Affairs in the United States remarked that in four years time the United States would be the second naval power in the world, the statement came as a shock to many people on this side the Atlantic. Yet Senator Hale proved the truth of his assertion by tabulated statistics, which admitted of no dispute, and if this new design of battleship prove to be practicable, the United States will be making a very good bid for first place.

At the present time, the United States has twelve battleships in commission, and thirteen in various stages of construction. There are two armoured cruisers completed, and ten under construction (including the two of the *North Carolina* class, which have been tendered for, but for which no contracts have yet been awarded). There are eight protected cruisers, completed, and four more approaching completion, while there are sixty-three smaller vessels completed (including eight submarines, and eleven under construction).

In this connection, it may be worth while noting that since January 1st, five vessels have been completed, and commissioned. They are the battleship *Ohio*, and the protected cruisers *Denver*, *Des Moines*, *Tacoma*, and *Chattanooga*. Up to October 30th, eleven vessels have been launched for the United States navy, six battleships, two armoured cruisers, one protected cruiser, two gunboats. In addition, the battleship *New Jersey* and the protected cruiser *Milwaukee* are expected to be launched before the end of the present year.

The new armoured cruiser *Colardo*, on her full-speed trials, recently made an average speed of 22·27 knots on a four hours' run, and a maximum on the measured mile of 23·3 knots. Being only designed for 22 knots, this extra knot is very good, and augurs well for the success of the class generally. The h.p. developed was 28,000, and the average revolutions 128.

The gunboat *Chattanooga* was commissioned for service on October 11th, but it is stated that she is far from completed, and much internal work remains to be finished. The *Paducah*, gunboat, was launched on the same day at New York.

THE PORT OF LONDON.

Dock Officials' Reply to the Critics.

MR. PARKER SMITH, M.P., speaking at a launch luncheon at Glasgow a few days since, indulged in the following comparison :—

"The Clyde Trust had shown itself equal to the needs of shipping in deepening the river. The Clyde was a model, and contrasted with the Thames, which suffered from the want of an authority to bring its resources up to date He recommended shipping trusts to take the Thames as a warning and the Mersey as an example."

Armed with this latest criticism on the Port of London, a representative of PAGE'S WEEKLY waited upon the London and India Dock Company, the commanding position of which, in regard to Thames trade, entitles its officers to speak for the Port.

He discussed the matter with the Hon. Sydney Holland, the vice-chairman, and Mr. Broodbank, the secretary, who had seen the report of Mr. Parker Smith's speech.

"These attacks on the Port of London are both an old and a new story," it was remarked. "Old because the Thames has never been without its critics, and new because those who make the attack do so with a real air of saying something quite original.

"In this way," said Mr. Holland, "the Thames has acquired a reputation in the minds of the uninformed which is altogether undeserved. Hard things have been so often said that some people begin to think there may be some truth in them. It ought to be possible to praise the management of the Clyde, and to say a good word for the Mersey without making an attack on the Thames. It is unnecessary to say that the Port of London need fear no comparison. These attacks, however, go on, and nobody seems to care. We have no sooner disposed of one critic than we find another coming up on the tide."

"Our representative hinted that London is too big—too dissociated to feel that pride in its river and its dock which is displayed at Liverpool or Glasgow. London is, in fact, too cosmopolitan.

"There is a good deal of truth in that."

"Meanwhile," continued Mr. Holland, "London is running grave risks by the delay in dealing with the Port question which has been raised by the Government, and apparently been left by them to be settled by someone else. Shipping coming to the Port increases year by year—1903 was 800,000 tons more than 1902. No money will be spent on new dock accommodation while matters are hung up as they are now. New dock works cannot be constructed in a week, so that unless something is done soon London will wake up one day to find out that shipping entering the Port cannot be accommodated.

Then Mr. Broodbank came to close quarters with Mr. Parker Smith's statement.

"I do not wish to belittle the Clyde Trust. It has done good work, and the Mersey authorities are entitled to praise. Yet, in spite of all criticism, the Port of London remains the first in the world. Its arrangements may not be perfect, and, as a matter of fact, the London and India Dock Company has been in the field with proposals for reform which are only delayed because of the uncertainty of the position. As you know, the management of the Thames is in the hands of a number of authorities, including the Thames Conservancy and Trinity House, and, in spite of its not being under a single control we maintain that the interests of shipping are fostered as they are nowhere else."

Mr. Broodbank then proceeded to quote some interesting figures.

The tonnage of London for 1903 was 17,075,313, compared with Liverpool 10,991,939, Hamburg 9,156,000, Antwerp 9,115,372, Cardiff 9,670,945, and Glasgow 3,899,511."

"Another point made by the critics," said our informant, "is that London is losing trade, and when it is pointed out that the trade has increased, they say that the percentage of increase has not been so great as that of other ports, notably Hamburg, Rotterdam, Antwerp, and Southampton. Naturally, the increase of London trade has not shown so large a percentage as that of other ports with smaller figures. But, as was pointed out by the Royal Commission, London is a final port of discharge and not a calling port. Calling ports, where vessels merely touch at to collect a few tourists or only a small amount of cargo, will easily show a larger increase of tonnage, but such vessels bring very little grist to the mill. Such comparisons are, therefore, fallacious."

Regarding the question of the approach to the Thames, the attention of our representative was called to the article by Sir Henry Le Marchant, a director of the Company, in the "National Review," in which he claimed (and his claim has never been contested) that "the Thames is a far superior approach to its port than the Elbe is to Hamburg, the Maas to Rotterdam, the Scheldt to Antwerp, or the Weser to Bremen. None of these rivers are at all equal to the Thames, where, up to Tilbury there is a maximum depth of 43 ft., and up to the Albert Dock of 37 ft."

With reference to dock accommodation, some instructive figures were supplied by Mr. Broodbank.

"The Thames dock accommodation," he said, "includes 640 acres of water area with a length of quay of 143,000 ft., of which 430 acres of water and 106,000 ft. of quay belong to the London and India Docks Company. The wharves and jetties in the river are estimated to give another 80,000 ft. of quay, so that in all the quay accommodation of London amounts to 223,000 ft., or upwards of forty miles. I may add that boats which could come into the Thames could not enter other ports. Take, for example, a boat such as the *Celtic*. Her length is 680 ft., and width 75 ft., and she draws, fully laden, about 31 ft. Such a boat could not get up to Hamburg, Rotterdam, Amsterdam, or Bremen, at all, and except on high spring tides she would be unable to get into Glasgow or Hull. If she got up to Antwerp she would be lucky. Even at Liverpool the boat could at present only go into dock when the spring tides were favourable. In the Port of London she could get into Tilbury Dock a long time before high water."

"The critics, Mr. Broodbank, say that London is a dear port. What do you say to this?"

"I know they do, but it is quite a fallacy. With reference to charges on goods London is the cheapest port in the United Kingdom, and that for the reason that it is an absolutely free port. At all other ports in the kingdom, with the exception of Hull, goods have to pay dues merely for the privilege of loading or discharging. In the case of London, goods have to be landed on the dock quays before we can make any charge, and 76 per cent. of the import goods and 80 per cent. of the export goods pay no dock charge whatever."

"Let me say in conclusion," he added, "that the London and India Docks Company have spent £20,000,000 on their undertaking, and that London is at present not so much behind the times in the matter of accommodation afforded to the shipping trade, as Mr. Parker Smith infers."

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

	Last Day.
London.—Supplying one steam motor and bogie for steam motor carriage. Agent-General, South Australia, Threadneedle House, Bishopsgate Street, E.C.	Nov. 28
London.—Complete wiring installation for electric lighting of new workhouse and infirmary at Wormwood Scrubbs; also two motor transformers and battery for Hammersmith Board of Guardians	Nov. 15
London.—Supply of rolling stock for South Indian Railway. Particulars of Sir Geo. Bruce, 3, Victoria Street, S.W.	Nov. 15
London.—Erection of fire mains, electric bells, gas lighting, etc., Hearts of Oak Benefit Society Offices, Euston Road. The Secretary, 17, Charlotte Street, Fitzroy Square	Nov. 7
Cardiff.—Competitive designs and tenders for supply of pumping machinery, and plant required in connection with the proposed western district main outfall sewer. Contract No. 1—for combined sewage pumping engines and pumps of a maximum capacity of 700,000 gallons per hour; 2—for the steam generating plant required for Contract No. 1; 3—for two sets of gas engines and centrifugal storm-water pumps, each capable of discharging 680,000 gallons per hour. Particulars at the office of Mr. W. Harper, borough engineer, Town Hall, Cardiff	Dec. 17
Cardiff.—Construction of $5\frac{3}{8}$ miles of railway for the Cardiff Railway Company. Particulars of Sir Douglas Fox and Mr. Robert White, Royal Charter, Park Place, Cardiff	Nov. 17
Great Yarmouth.—Supply of about 800 tons of steel girder tramway rails, etc., for Town Council. Mr. W. Edgar Stephens, Town Clerk	Nov. 22
Preston (Lancs.).—Supplying of about 2,000 tons cast iron pipes, together with castings, for Corporation. Mr. Thos. Cookson, Town Hall, Preston	Nov. 12
Batley.—Erection of fence and retaining walls for the Town Council. Mr. J. H. Craik, Town Clerk	Nov. 5
Swanage.—Construction of retaining wall for the Council. Mr. T. Randell, Clerk.	Nov. 5
Edinburgh.—Erection of City wall for the Corporation. Public Works Office	Dec. 5
Wokingham.—Supplying and laying water mains for the District Council. Mr. J. F. Sergeant, Clerk	Nov. 5
Romney Marsh.—Supply of two steam rollers, etc., for making up road. Mr. W. B. Smith, District Surveyor	Nov. 9
Skegness.—Improving and extending Sewage Works, supplying and delivering cast-iron pipes for the Council. Mr. G. T. Dashper, Clerk	Nov. 11
Somerset.—Sinking of well in connection with the Somerset and Bath Asylum. Mr. W. Phelps	Nov. 30
Hambledon.—Supplying and laying of water mains for the Council. Mr. F. Smallpeice, Clerk	Nov. 9
Wrexham.—Metalling and making good a street for the Corporation. Mr. T. Bury, Town Clerk	Nov. 14
Surbiton.—Construction of storm water drains for the Council. Mr. J. Bell, Deputy Clerk	Nov. 7
Dover.—Supplying and laying water surface drains for the Corporation. Sir W. Knocker, Town Clerk	Nov. 15
Dundee.—Relaying copper strip mains with insulated cables	Nov. 12
Erith.—Electric lighting of the offices of the Erith Education Committee at Picardy	Nov. 11
Hammersmith.—Electric wiring for new workhouse at Wormwood Scrubs; also two motor transformers, and a battery; for the guardians	Nov. 15
Great Western Railway.—470 tons of steel girders and other iron and steel work of British manufacture. The Engineer, Paddington Station	Nov. 8
Ballinasloe.—Wiring temporary building for electric light. The Superintendent, Ballinasloe Asylum	Nov. 14
Bootle.—Steel girder bridge for the Council. The Engineer. Deposit £2 2s.	Nov. 15
Whitby.—Supply and erection of one 200 kw. direct current dynamo, coupled to a high-speed engine (reciprocating or turbine type), and one watertube boiler, fitted with chain grate and mechanical stoker. Mr. L. H. King, Electrical Engineer	Nov. 21
Manchester.—For the wiring of Stuart Street Station for arc and incandescent lighting. Electricity Committee	Nov. 11

COMING CONTRACTS.

Liverpool.—The Corporation is seeking power to borrow £400,000, and an inquiry has been held.

Southport.—An inquiry has been held in regard to the proposal for a loan of £20,000 in connection with electric lighting requirements.

Stockport.—The local tramway system is to be taken over by the Town Council, with the view to conversion to electric traction.

Tiverton.—The Council has made an application with regard to capital for electric supply purposes.

Bury.—Tramway extension is about to be made the subject of a Bill.

Mexborough.—The Council intends to apply for a loan of £4,000 for electric supply purposes.

Rhyl.—Electric supply extensions are imminent. The Council intend to spend £2,610.

Battersea.—The Borough Council are about to apply for sanction to spend £10,000 on tar macadamising and other works.

Islington.—Estimates have been passed for extension of electric lighting and other works.

Eccles.—An inquiry has been held into the Council's application to raise £6,115 for public arc lamp lighting and street improvement.

Hexham.—An inquiry has been held in regard to an application by the Council for a loan of £14,280 for extension of mains and other works.

CONTRACTS CLOSED.

London.—The County Council have accepted the following tenders in connection with the Greenwich electricity generating station and the New Cross and Camberwell car sheds: Pumps, motors, strainers, etc., Electric Construction Co., Ltd., £8,083; steam and exhaust piping, valves, etc., John Spencer, Ltd., £9,785; condenser and other piping, valves, etc., James Oakes and Co., £6,418; three electric car traversers, £1,456.

London.—The County Council have accepted the following tenders in connection with thirty new steamboats for the Thames service:—Thornycroft and Co., ten boats at £5,950 per boat; Thames Ironworks Shipbuilding and Engineering Company, Ltd., ten boats at £6,500 per boat; and Napier and Miller, Ltd., ten boats at £5,950 per boat.

London.—The County Council have given out a contract to Holden and Brooke, Ltd., for eight Brooke's water separators. Also six separators for Rotherhithe.

London.—The Post Office has accepted the tender of The Sunbeam Lamp Co., Ltd., of Newcastle-on-Tyne for 3,000 vacuum protectors.

North Staffordshire Railway.—The directors have accepted the tender of Beyer, Peacock and Co., Ltd., for the construction of two motor vehicles at a cost of £2,000 each.

Barry Railway.—The directors have given an order to Hudswell, Clarke and Co. for six main line locomotives.

Taff Vale Railway.—Kerr, Stuart and Co., Ltd., have received an order for six motor coaches.

West Ham.—The Corporation have accepted the tender of P. and W. McLellan for the whole of the tie bars, fish bolts, and bonds required for the new electric tramways.

East Ham.—The Council have accepted the tender of Dick, Kerr and Co. for 50 tons of tram rails at £6 10s.

Sheerness.—The Admiralty have placed an order with Davey, Paxman and Co. for the supply and erection of four high speed engines of an aggregate of 1,800 h.p., for the generating station at Sheerness Dockyard. Storey and Sons, Ltd., have received a contract for three sets of condensing plants.

Burslem.—Tenders have been accepted for the erection of electric light and destructor buildings at a cost of £3,745.

Exeter.—The Council have accepted the tender of Mr. W. E. Blake, Plymouth, for the superstructure of the tramcar shed at £4,265.

Perth.—The Corporation have accepted tenders from Callender's Cable and Construction Company, Robert W. Blackwell and Co., Ltd., and Hurst, Nelson and Co., Ltd., in connection with the reconstruction of the tramways.

Devonport.—The Corporation have placed an order with Willans and Robinson for a steam engine at £3,445.

Erith.—The Council have accepted the tender of Gunning and Sons for the erection of car shed at £7,215.

Handsworth.—The Council have accepted the tender of the A. B. P. Accumulator Co., of Stockton, for 256 19-plate cells of Standard S. type.

Hackney.—The Council have accepted the tender of Fabius Henrion-Nancy, for carbons for open arcs.

India Office.—The tender of Bruce Peebles and Co., Ltd., for generators, motors, motor-generators, and balancers for the Oudh and Rohilkund railway shops has been accepted. The price is £4,900.

APPOINTMENTS VACANT.

	Last date for application.
Birmingham. — Lecturer in electricity and physics, at the Municipal Technical School. Salary £140	Nov. 19
Battersea.—Electrical engineer, to take entire charge of Borough Electric Supply Department. Salary £400...	Nov. 15
Cairo.—Public Works Department inspector of irrigation. Salary £1,000 (Egyptian)	—

APPOINTMENTS FILLED.

Belfast. — Mr. J. H. Smith, D.Sc., of Sunderland Training College, has been appointed head of the mechanical engineering department of the Municipal Technical College.

Buenos Ayres.—Mr. Fritz A. E. Nippel has been promoted general manager of the Anglo-Argentine Tramways Co.

Blackburn.—Mr. P. P. Wheelwright, as borough electrical engineer. Messrs. E. Johnston and T. H. Cowell as joint tramway managers.

Boston.—Professor H. E. Clifford to be acting head of Electrical Engineering Department at the Massachusetts Institute of Technology.

London.—Mr. R. A. Owen, late master of the Thames pleasure steamer La Marguerite, has been appointed as manager of the County Council Steamboat Service at a salary of £500 a year.

OBITUARY.

The death of Mr. F. C. Dobbing, a director of William Cory and Sons, Ltd., removes a prominent figure in London and Tyne coal and shipping circles.

Meeting of the Iron and Steel Institute at New York.

THE NATURE AND FUNCTIONS OF THE REGENERATIVE STEAM ACCUMULATOR.

(*Continued from page 500.*)

The Rateau turbine is now universally known, and it would be useless to repeat the description of it, particularly as the author himself has so lucidly set out the principal advantages of his remarkable system in the communication made before the meeting of the Institution of Mechanical Engineers, this year. Mr. Rateau also referred to the mixed turbine. These turbines having an important bearing on our subject, it would be well to recall, briefly, the present special advantages for the rational regeneration of waste steam.

COMPOUND TURBINE SYSTEMS.

During these periods when the low-pressure turbine is fed with live steam coming directly from the boiler; and previously expanded, its consumption per horse-power hour will evidently be higher than it would be under similar conditions in an engine working in the ordinary way, with the full pressure of the boilers, 33 lb. per horse-power hour, for example, instead of 22 to 26·5 lb.

If the engine which supplies the exhaust steam is working fairly regularly, the demand for live steam will only arise for a small proportion of the total time, so that the somewhat increased consumption during this period will have but little influence on the gross cost. This will not, however, always be the case, as, for example, when the secondary plant is required to work regularly throughout the night as well as during the day.

It is possible, therefore, to so arrange conditions that the turbine may at all times work as economically as possible, by supplementing it with a high-pressure turbine, intended to take the steam direct from the boilers during stoppages of the engine furnishing exhaust to the low-pressure plant. The exhaust from the high-pressure turbine can be utilised by the low-pressure turbine, which can thus derive its supply either from this source or from the accumulator. This group of a pair of turbines must be regarded as a high-pressure system, capable of at all times receiving and utilising to the best advantage steam derived from primary sources. It is to be understood that the admission of live steam at high pressure, as well as of that at low pressure, is automatically controlled, according to requirements, by an appropriate regulator.

With an ordinary vacuum this group will only consume 17·6 lb. of steam per electric horse-power when working at full speed, with, for example, a feed at 114 lb. per sq. in., and as has already been shown above, 26·5 lb. to 36·5 lb., according to conditions, if it requires only exhaust steam at atmospheric pressure.

By the simple arrangements just outlined, the engine is enabled to work continuously under the most advantageous conditions. During the time that there is no exhaust steam available, it is simply a high-pressure plant using in the most advantageous way live steam; when low-pressure steam becomes available, the plant profits by it, by effecting a proportional reduction in the consumption of high-pressure steam. Indeed, the compound high and low-pressure turbine can be fed, not only by two supplies of steam at different pressures, but by three or four supplies which cannot be done with the same facility by piston engines. Thus, at the Mines de la Réunion in Spain, the regenerative steam installation comprises two groups of 300 h.p. turbines, which can be supplied either simultaneously or separately with low-pressure exhaust steam or by steam coming from one group of generators at 71 lb. per sq. in., or from another group at 170 lb. per sq. in. In small plants the two engines are usually combined in one shell.

ADVANTAGES OF THE RATEAU SYSTEM EMPLOYED WITH CENTRAL CONDENSERS.

If a central condensing plant is already installed, the accumulator and turbine can be interposed between the condenser and the sources of supply. Besides the much more economical utilisation of the power thus obtained, this arrangement possesses the advantage, in cases where the pressure of the steam furnished to the turbines is above that of the atmosphere, of preventing the entry of air into the connections through which the steam passes.

It must be noted, however, that the turbines can be supplied with steam at a pressure lower than that of the atmosphere, if it is undesirable to sensibly reduce the counter-pressure of the main engine and so impede its working. Even with pressure only one-half that of the atmosphere, it is still possible to obtain, as will be seen from Table I., an electric horse-power of 36·4 lb. of steam per hour.

It may appear, *à priori*, strange that in these various instances the interposition of an accumulator-turbine group should be more efficient than simply allowing the condenser steam to feed the engines in the ordinary way. The benefit accrues from the fact that the turbines allow of the expansion of the steam being carried to its extreme limit, and that they still yield an excellent result with low pressures, whereas the reverse is the case with piston engines. With turbines it will be found that 65 to 70 per cent. of the power theoretically available, through expansion from atmospheric pressure to that of the condenser, is obtainable, while piston engines only yield under these circumstances 35 to 40 per cent. of the same power. In other words, a far better result is obtained from the calorific energy available in the steam from the boilers when, for high pressures, piston engines are employed, and, for low pressures, turbines. Calculations show still more clearly the justification of the foregoing claim. Suppose, for example, that the average consumption of the engines, freely discharging exhaust steam into the air, be *n* lb. per useful horse-power per hour, we can determine the benefits arising—

(1) From the application of condensation in the ordinary way.

(2) From the addition to the installation of an accumulator-turbine system.

I. Condensing corresponds to a saving in consumption of 15 to 20 per cent., so that under these conditions each useful horse-power developed by the engines supplying exhaust corresponds to the supply of steam equalling $0{\cdot}2n$. If this available steam be employed in a high-class motor of the piston type, actuating a dynamo, and consuming, say, 16·5 lb. per electric horse-power hour, the increased power obtained will be

$$\frac{0{\cdot}2m}{16{\cdot}5} = \frac{n}{82{\cdot}5} \text{ electric horse-power.}$$

II. By employing a turbine the exhaust steam at atmospheric pressure will develop one electric horse-power per 31 lb. of dry steam expended. The weight *n* escaping from the boilers will yield about $0{\cdot}8n$ of dry steam, allowing for 20 per cent. of condensation in the primary engine and the connections. This weight ($0{\cdot}8n$) of steam would be capable of developing in useful work

$$\frac{0{\cdot}8n}{31} = \frac{m}{38{\cdot}7} \text{ electric horse-power.}$$

Thus, in the second case an efficiency more than double that of the first is obtained.

The relation between these two figures is, by the way, quite independent of the degree of perfection to which the primary machine might be brought.

		Pressure of Supply in lb. per sq. in,		
		28·4	14·2	7·1
Pressure of exhaust in lb. per sq. in.	1·13	20·5	26·5	36·4
	1·85	23·6	31·8	47·5
	2·56	26·5	36·4	61·8

TABLE I.

If it is desired to benefit the primary machines by a certain degree of condensation, there is nothing to prevent the feeding of the turbines with steam at a pressure below 14 lb. per square inch. Table I. shows the actual consumption of steam which can be obtained under the various conditions realised in practice. The first horizontal column corresponds to the employment of a surface condenser with a vacuum of 27·5 in. of mercury; the second, to a mixed condenser with a vacuum of 26 in. of mercury; and the third, to an ejector condenser giving a vacuum of 24·6 in. of mercury.

The central vertical column relates to the normal case in which the turbine employs steam at atmospheric pressure; the first, to the case in which, with the object of developing the full advantage available from the turbine, the pressure of the exhaust steam has been raised to 42·6 lb. absolute pressure per square inch; and the third corresponds to the employment by the turbine of an exhaust at only one-half the atmospheric pressure, when it is undesirable to hamper the working of the primary engine.

It may happen, in a plant consisting of primary engines, an accumulator-turbine system, and a central condenser, that the turbine will work during a portion of the day at slower speed. It is only necessary in this case—the free exhaust valve being adjustable—to reduce the resistance of the spring controlling the latter to establish a low pressure of, say, 7·1 lb. per square inch throughout the whole system. The engines will thus derive a larger proportion of the benefits arising from condensation, and the running of the turbine will be still more economical, for, as has been already indicated, it is possible under these circumstances to obtain an electric horse-power with a consumption of only 46·5 lb. of steam per hour.

If there is nothing to prevent the reduction of the pressure of the exhaust from the primary engine, even greater advantages accrue. Take, for example, an engine consuming, with free exhaust, 13,200 lb. of steam per hour, with an average of 100 lb. per useful horse-power. Let us also assume the absolute steam pressure to be 71 lb. per square inch on admission to the power cylinders. If exhaust takes place at atmospheric pressure, the consumption of the turbine per electric horse-power hour will be about 31 lb. The 13,200 lb. of steam expended by the primary engine, reduced by condensation to 10,600 lb., will therefore furnish the turbine with a supplementary supply of power of

$$\frac{10{,}600}{31} = 341 \text{ electric horse-power,}$$

or a total of 471 useful horse-power, which makes the consumption per useful horse-power per hour, about 28 lb.

If the pressure of the initial exhaust be now raised, say, to 42 lb. per square inch, the steam will have to be introduced at a pressure of 100 lb. per square inch at least, instead of 71, and the area of inlet increased by about 25 per cent. in order to furnish a similar system with the same amount of power. The consumption per hour will then become, approximately,

$$13{,}200 \times \frac{100}{71} \times 1{\cdot}25 = 23{,}100.$$

The turbine will therefore benefit to the extent of $0{\cdot}8 \times 23{,}100 = 18{,}600$ lb. of dry steam per hour, at a pressure of 42 lb. per square inch. With this supply the consumption of the turbine per electric horse-power and per hour will fall to about 22 lb. The power rendered available by this means becomes

$$\frac{18{,}600}{22} = 850 \text{ electric horse-power.}$$

that is to say, it rises to nearly treble the amount developed in the former instance.

23,100 lb. of steam would yield a total of 980 h.p., which reduces the consumption of the system per useful horse-power per hour to about 23·5 lb. instead of 28, which was the case with steam escaping at 14 lb. per square inch.

These figures are much in advance of those usually obtained, even in the most highly perfect engines.

Saving Effected.

The economy resulting from the application of the Rateau system can be ranged under two heads.

1. Saving in the Cost of Installation.—If the first cost of a turbo-electric plant with accumulator be compared with that of an electric plant with a piston engine and boilers, there is a marked saving in favour of the former. The difference arises from the substitution of a regenerative accumulator for the other sources of steam supply, which are much more costly, and also from the much lower first cost, and cost of laying down of the electro-turbine as compared with the cost of dynamos and piston engines capable of developing the same power. It is natural that the relative importance of these various elements should vary according to the additional power required, the weight of the accumulator, or the conditions under which the prime motor works, and of the general method of exploitation. The great variations in the cost of engines are also an important obstacle in the way of giving exact figures. It follows, however, from the comparative estimates made between the different combinations intended to produce a certain power by the method of the accumulator and turbine, and again by piston motors with the ordinary generator, that the economy of setting up the plant by the Rateau system is always very marked, and may, in the case of attaining 500 h.p., for example, reach £1,600 to £2,000. Furthermore, it is well to note that when a central condenser exists, it can be utilised for the low-pressure turbine, while an electric unit driven by live steam needs, as a rule, a special condenser.

2. Saving in Cost of Working.—This item is obtained by the reduction of the number of men employed at boilers; by the lowering of the amounts to be set aside for redemption; cost of installation and interest on capital; and, in particular, by the diminished consumption of fuel.

If the preceding example of a 500 h.p. electric installation be again taken, and a daily shift of twenty hours be assumed, the annual saving will work out as follows:—

Saving in coal over 300 days at 1·2 kilogrammes per horse-power (coal at 10s. per ton)	£1,728
Saving in reduction on capital charges and on interest on capital, say, at 15 per cent. on £1,600, for example	240
Wages for two stokers, say	148
Saving in lubricating oil, about	200
	£2,316

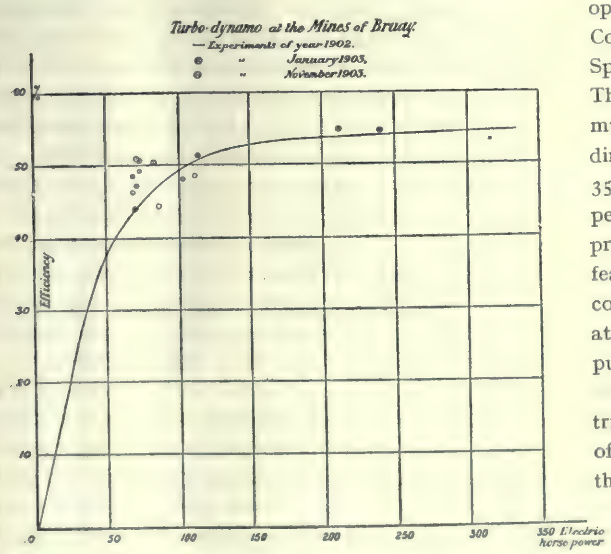
The estimate for the cost of fuel is, of course, arbitrary. The saving realised at some collieries where the selling price of coal is but 7s. 6d., 5s., or even 4s. per ton, will be somewhat lower. On the other hand, at some steelworks where the usual price of coal ranges from 12s. to 16s. per ton, and where the engines run, as a rule, day and night, the annual saving in such cases as those under consideration would amount to nearly £4,000 for a daily average of twenty-four hours. In such cases the cost of installation would be recovered within eighteen months by the saving in coal alone.

APPLICATIONS OF THE RATEAU PROCESS ALREADY IN OPERATION.

The process was applied for the first time at Bruay, where, since August, 1902, when it was installed, it has given very satisfactory results. Mr. Rateau has, in his recent communication to the Institution of Mechanical Engineers, given a complete description of this installation, and has shown, amongst other points which it is well to remember, that, from experiments which have been made at various periods since its erection, the working of the accumulator has throughout been most regular, and the efficiency of the turbine has been maintained under capital conditions. It must be remembered that, at Bruay, the exhaust steam from a winding engine, regulated by preference by means of a mixed accumulator with iron trays, feeds a low-pressure turbine of 300 h.p., which in turn operates two dynamos coupled up from the same shaft. It is worth noting that, since the beginning of May last, the turbine has been working steadily day and night, as would be the case with such installations of low-pressure turbines as would be adopted in steel works.

Numerous installations of the Rateau system are under observation, or in course of erection, both in France and abroad, at steelworks and at collieries. As particular instances the plant at the Donetz Steelworks in Russia, and the Poensgen Steelworks at Düsseldorf, the installation of which is on the point of completion, and which presents features of special interest as regards steelworks, may be cited.

Donetz Steelworks.—The plant consists of a double-bodied, horizontal, mixed accumulator, with cast-iron trays and water, capable of controlling 55,000 lb. of steam per hour, and intended to feed four groups of electric generators of 350 h.p. each. The turbines utilise the exhaust from a three-cylinder, reversible engine driving a rail-mill. It is proposed to further utilise the exhaust of a second reversible engine which will make the total regenerated power equal to 2,000 electric h.p. The energy developed by this powerful central station is intended to light the works, to convey power, to actuate various machines, and for electric furnaces and electric welding purposes.



The Poensgen Steelworks, Dusseldorf.—The management are erecting a mixed accumulator, consisting of a single vertical body containing cast-iron trays and water. The plant will serve to regulate a supply of 26,000 lb. of steam per hour, in spite of the fluctuation of the general supply, which may vary by 810 lb. The exhaust to be utilised is derived mainly from the rolling mill engines and the steam-hammers. The regulated current of steam from the accumulator will feed an electro-motive group formed by a low-pressure 650 h.p. turbine, and a continuous current dynamo. It is of interest to note that this plant, which is in course of construction, is to work in connection with a central condenser already in existence. The accumulator will allow of the exhaust from the hammers being taken to the condenser, which has hitherto been regarded as impossible owing to the irregularity and violence of the steam discharge from these machines, which completely destroy the constancy of the condenser vacuum.

Of installations which will very shortly be put into operation, it will suffice to mention the Firminy Collieries in the Loire, the Mines de la Réunion, in Spain, and the Mines de Béthune (Pas-de-Calais). The latter should be more especially noted, inasmuch as the low-pressure turbine will be used for the direct driving of a Rateau centrifugal compressor of 350 h.p., capable of producing 128 cubic feet of air per hour (measured at atmospheric pressure) under a pressure of 85·3 lb. per square inch. This is a feature of great interest to steelworks, inasmuch as compressed air, produced, by means of these turbines, at a small cost, could be utilised for blast-furnace purposes, for cupolas, and for Bessemer converters.

These different applications, added to the numerous trials which are actually being carried out on the whole of the plants which have been described, show clearly the interest they present, both from a common-sense point of view and from a practical standpoint.

THE WEEK AMONG THE TECHNICAL SOCIETIES.

THE INSTITUTION OF CIVIL ENGINEERS.

THE PUBLIC WORK OF INDIA AND CEYLON.

THE opening meeting of the eighty-sixth session of the Institution was held on Tuesday last, when Sir Guilford L. Molesworth, K.C.I.E., the new President, delivered his inaugural address.

Sir William White, the retiring President, occupied the chair, and among those present were Sir Benjamin Baker, Professor Unwin, Col. Crompton, Sir J. Wolfe Barry, Mr. Alex. Siemens, Dr. Kennedy, Mr. C. Hawksley, Sir Alex. Binnie, Sir John Thornycroft, Sir William Preece, Mr. J. C. Hawkshaw, Mr. Yarrow, Dr. Elgar, Sir George Bruce, Mr. R. A. Hadfield, and Dr. Tudsbery (secretary).

Sir William White, in opening the proceedings, said : Gentlemen,—I now come to the final act I have to perform as President of this Institution. It is to introduce to you my successor in this chair, a gentleman whose name is a household word wherever English engineering prevails, a gentleman who has done distinguished public service, who has been connected with the Institution for a very long period, who has served the Institution in many ways and for many years, and who will, I am sure, be a worthy successor to the long line of presidents who have occupied this chair.

Sir William White then vacated the chair in favour of the incoming President.

VOTE OF THANKS TO SIR WILLIAM WHITE.

Sir George Bruce : I have much pleasure in rising to move the following resolution :—

"That the members present at this meeting desire on behalf of themselves and others to record their high appreciation of the services rendered to the Institution by Sir William White during his term of office as President."

I propose that resolution with very great pleasure, feeling assured that it will be received by you all with fitting enthusiasm. We know how well our esteemed President has performed the duties and maintained the honourable traditions of the chair, and how he has exerted himself to extend the usefulness and the influence of this great institution. We know how well he has succeeded in that effort. When Sir William White became President he reminded us that he was the first naval architect who had occupied that honourable position, and now at the end of the year of office we desire cordially to congratulate his fellow-craftsmen on the dignity and efficiency with which he has discharged his duties; There have been laid upon Sir William White additional obligations and responsibilities beyond those home duties which all presidents in succession fall heir to. At the invitation of the Institutions of Civil Engineers of the United States and of Canada respectively, Sir William, supported by a goodly contingent from this parent Institution visited those lands, where they were received with a boundless hospitality, and everything interesting to engineers was laid open to their consideration and criticism.

The details which have reached us on all hands of these scientific and hospitable wanderings in the great Republic, and in Britain's great Colony, testify to the wonderful facility and aptness with which Sir William discharged his various duties as leader of the band, and as spokesman for this Institution to our blood relations in the United States and our fellow-subjects in Canada. To satisfy the requirements of transatlantic hospitality at every turn is not easy and not always safe, and to make speeches without end, mingling the scientific with the gay is a task which would not lie lightly on the shoulders of very many. Yet Sir William White has come out of that ordeal triumphant and unscathed, and we now right gladly welcome him home again, well and strong. If the Council will arrange, as I hope it will, for Sir William to occupy an evening with an account of his wanderings and his anticipations of their results, I am pretty sure he will foreshadow that these gatherings of American and English engineers will be a powerful influence for good in binding together in peaceful if unwritten alliance the English speaking people of the world, and linking the homeland and our widespread Colonies together in a firmly-knit Empire, whose banner is peace.

Sir Benjamin Baker seconded the resolution, which was put from the chair and carried with acclamation.

Sir William White : I find it no easy matter to express my feelings of gratitude for the very kind expressions which have been used by Sir George Bruce in proposing this resolution of thanks, and to you all for the manner in which you have received it.

It is perfectly true that in trying to the best of my ability to serve the Institution as I have done during the past year, I have myself found great benefit. You did not know, but I will tell you now, that a year ago, on the afternoon of the day I was to give my address here, as President, it was extremely doubtful —it seemed for a time almost impossible—that I could come here, but I came, and all through the year as I have worked for the Institution I have grown stronger and come back again to my old form. The past year has been with me a year devoted mainly to the Institution. It was paying, to the best of my ability, a debt of gratitude, and now that the year is over I am able by your kindness to believe that the efforts I have made have not been fruitless, that the Institution has in many ways advanced, is indeed advancing; and to have contributed in any degree to such a result as that is a thing of which any man may be proud. If you gentlemen who have not been with us on the other side had been with us there, you would have been even more proud of the Institution than you are to-night. I can assure you that the feelings of devotion and regard for this parent Institution amongst American and Canadian engineers are beyond expression. To go there, as it was my good fortune to go, as the President of this Institution, was to secure a reception such as is given to few men, and that quite apart from any personal claim to consideration. The reception given to us was due to the fact that the character of this Institution was understood and appreciated on the other side of the Atlantic, and that the prestige conferred by membership is recognised there as well as here. We know that this is true throughout the world; and we as members of this Institution have our part to play, so that those who come after us may find the same thing true. The position this Institution holds has only been achieved by many years of faithful work on the part of those who have gone before, and can only be maintained by faithful work on the part of those who have charge of the destinies of the Institution in the time to come.

Gentlemen, I do not wish to stand longer between you and the address we are all desirous of hearing from our respected President, but I should like to say, if I may, that it seems to me that the year during which I have been President will be not only marked in our annals by this new departure, the visit to a greater continent, but by other things which should not be overlooked, although they may be overshadowed by this last event. We shall think of this as the year in which the Institution, on the advice of its Council, has assumed a position which, like the visit to America, was also unprecedented, and has become the guardian, the faithful guardian, it will be, of that great institution which has been committed to its care by Mr. Yarrow. I could not leave the chair without saying that one of the most cherished memories of my year of office will be that I was able to help my friend to make safe the future of that institution.

Another thing I feel bound to mention, and that is with regard to the constitution of a representative committee on engineering education. There, gentlemen, I think we are only at the beginning. In America and Canada I have been able to learn much from those engaged in similar work, and I am sure of this, that while we have much to learn in this country in the matter of engineering education, we have also not a little to teach. I believe that by the faithful study of what is being done elsewhere, and by the due development and co-ordination of what we possess already, we shall, through the Committee, do something that will place on a permanent and better footing the education of engineers. I have to thank you again for the vote of thanks and to say that the fact that I have been President of this Institution is to me an honour that is approached by nothing else which has happened in my career, and that although I cease to be President, the Institution will have no more faithful servant in the future than myself.

PRESIDENTIAL ADDRESS.

Sir Guilford Molesworth then delivered the Presidential address.

The President said that he had selected for his subject the public works of Ceylon and India, with which he had been associated for more than thirty years, and which afforded not only a large field but an admirable training-ground for the civil engineer. The apathy of people at home regarding Indian affairs was proverbial, and the vastness of our great dependency was often overlooked. India was, in fact, a vast aggregation of countries, inhabited by races of varying customs, manners, and religions, and having no less than forty different languages in common use. This continent—for it was nothing less—had its affairs administered by a handful of Europeans, a staff which, as Lord Curzon has said, would be inadequate for a second-rate European kingdom. This, however, could be said for it, that it was the purest administratio in the world.

The present public works policy of India might be said to have been inaugurated by Lord Dalhousie about fifty years ago. There could be no doubt that at first, and for many years, the interest on the capital required for the construction of the large irrigation works and railways put a heavy strain on the revenues of India, and it was only of late years that it had emerged successfully from the ordeal, and now, as a whole, the railways yielded to the State a revenue of about 2½ millions sterling.

IRRIGATION SYSTEMS.

Fifty years ago, with the exception of that magnificent work the Grand Trunk Road from Calcutta to Delhi, the means of transport and communication were deplorably bad. Many of the public works of India were necessary by reason of climatic conditions—notably systems of artificial irrigation. This had been the case not only in our day, but from time immemorial, as was attested by the ruins of gigantic works in India and Ceylon, which, owing to changes of dynasty, internecine wars, and other causes, had been allowed to fall into decay.

The ruins of tank-works were found in all parts of Ceylon. The Giant's Tank dated back to the fifth century, and its embankment had been traced through fifteen miles of dense jungle. The great Kalawewor tank had a circumference of forty miles. Latterly the question had been revived, the Giant's tank and others had been restored, and £330,000 set apart for irrigation works in Ceylon.

These ancient works were also numerous in India. The amount of land now irrigated in British India was about 44 million acres. Of these 17 million acres were irrigated by canals, 8 million from tanks, and 19 million from wells and other sources.

The construction of the Grand Anicut, or dam, across the River Cauveri was said to date from the second century. It was restored by Sir Arthur Cotton in 1836 at a cost of £150,000, and now brought in to Government a revenue of £66,000. Sir Arthur Cotton also designed the great works of the Kistna and Godaveri deltas, which irrigated more than 1,000,000 acres.

The total width of the River Godaveri at the headworks was about 2½ miles on the islands, and there were about 500 miles of main and branch canals in the Godaveri delta, and about 1,700 miles of distributing channels. The largest canal was 184 ft. wide at bed-level, with a depth of 10 ft. The net revenue was about £157,000, or more than 12 per cent. on a capital expenditure of £1,273,000.

THE GANGES CANAL.

In Northern India irrigation was chiefly carried out by inundation and perennial canals. Inundation canals were those which had no permanent headworks, and were only suited to those rivers in which the flood level was higher than the level of the surrounding country. Though less costly than perennial canals in first construction, they were more expensive in up-keep. They were chiefly used in the Punjab and in Sind. Perennial canals irrigated land at too high a level to be served by inundation canals, and the most important of these was the Ganges Canal. The magnitude of its works, the difficulties of construction, the extent of its operations, and the originality and the boldness of its design were unsurpassed in the annals of engineering. It had been subjected to much criticism, and could not be regarded as absolutely free from defects. It was the first perennial irrigation scheme on an enormous scale, and the experience gained in its construction had been of incalculable value in later irrigation works, which had been based more or less upon it as a model.

The canal served a huge tract of country, extending 360 miles from its headworks. A dam at the intake, 500 ft. in length, extended across a branch of the River Ganges, where it debouched from the Himalaya mountains near Hurdwar. The dam was supplemented by fifteen scouring sluices, each 10 ft. wide. The canal at the headworks had a bottom width of 140 ft. and a depth of 10 ft.; but it diminished gradually as the water was drawn off by distributing channels.

At mile 180, the main canal was 80 ft. wide, and was divided into two branches, each branch having regulating sluices at the point of bifurcation. One branch, 170 miles in length, discharged itself into the Ganges near Cawnpore; the other, of equal length, into the Jumna at Haripur.

The Lower Ganges canal tapped the Ganges at Narora (about 160 miles below Hurdwar). It had a total length of about 260 miles of canal, in addition to those portions of the Upper Ganges which it supplements.

Amongst the more important works of the Upper Ganges canal were super-passages, or masonry aqueducts, which carried the waters of two rivers over the canal. The widths of these two rivers were 196 ft. and 296 ft. respectively.

SOLANI VALLEY AQUEDUCT.

Another costly work was the level crossing which enabled the Rutmoo torrent in flood to pass through the bed of the canal, and another thing worth notice was the great aqueduct and embankment which carried the canal over the Solani Valley. The aqueduct consisted of fifteen segmental arches of 50 ft. span, and the waterway on the embankment was 170 ft. in breadth, with a depth of 12 ft; the total length of the embankment and aqueduct being 2¾ miles. Among recent canals in India was the Chenab canal, in which work there were forty miles of main canals, 8,390 miles of branch canals, and more than 2,000 miles of distribution channels, serving about 2½ million acres of cultivable land. The capital expenditure was about £1,680,000, or about 13s. per acre. Yet notwithstanding the progress in irrigation, the rainfall of India was by no means fully utilised. The attempts to combine navigation with irrigation in the canals in India had not been attended with success.

A question of great importance from a sanitary point of view, in the prevention of plague, cholera, small-pox and other epidemics, was that of water-supply. Extensive water-works had been carried out, notably at Bombay, Calcutta, Madras, and Nagpur, and many of the larger cities had now a satisfactory water-supply; but much was still required in the smaller towns and villages. Another field for development, in which little had as yet been done, lay in the utilisation of the potential energy of rivers and mountain streams for industrial purposes.

RAILWAY DEVELOPMENTS.

Turning to railways, the President quoted the words of Sir West Ridgeway: "If ever there was a colony which is justified in believing implicitly in the advantage of an enterprising railway policy, it is Ceylon. The railways of this island have, during the forty years of their existence, contributed about 33,000,000 of rupees (£2,200,000) to general administrative purposes.".

The history of railways in India practically dated from 1853, when Lord Dalhousie issued his minute on railway policy, recommending the construction of that great system of trunk railways. The administration of Indian railways had passed through the following successive phases. At the outset the railways were constructed and worked by companies under a guarantee from the State. In 1870 the Government took over the construction and management of all new lines, and then came a third change of State ownership of railways managed by companies—a policy which involved all the evils of dual control and divided responsibility.

On the question of railway construction the rivers of India, said the President, presented very difficult engineering problems. Their vast size, their formidable power of erosion, their silt-bearing capacity, and their habit of wandering, rendered them very difficult of management. In flood-time, many of the rivers come down saturated with silt, which was deposited as soon as comparatively still water is reached. In process of time, the level of the river was gradually raised by constant deposits, until at length some of the channels burst through the raised bank, and the river cut a new course for itself, often wandering miles from its original bed.

Many of the valleys in the Himalayas were liable to huge slips, forming temporary lakes of enormous size, and when these burst they gave rise to terrible floods. Many years ago one of these caused a sudden rise of 90 ft. above the ordinary level of the Indus, at the point where the railway crosses it at Attok.

The rivers had wonderful silt-bearing and erosive properties. Instances were on record of sandbanks forming where, twenty-four hours earlier, there had been a deep-river channel.

At the junction of the Brahmaputra with the Ganges the Goalundo station, the terminus of the Eastern Bengal Railway was once threatened with destruction by erosion of the river bank.

In dealing with such rivers it was impossible to lay down any hard-and-fast rule. The conditions were dissimilar in every individual case, and each river must be a study in itself.

The magnitude of these rivers might be inferred from the fact that there were in India forty-five railway bridges more than a quarter of a mile long, twenty-five more than half a mile, ten more than three-quarters of a mile, one more than a mile and a quarter, two more than a mile and a half, and one more than a mile and three-quarters in length.

The mountain railways in India were numerous. The ascent of the Western Ghat had been made in four places. Of these the Bhore Ghat was the most difficult undertaking, involving an incline sixteen miles in length with a ruling grade of 1 in 37, a reversing station, and many tunnels.

Many of the frontier railways also involved very heavy works and numerous tunnels; notably, the Jhelam Pindi Railway, which passed through a very broken country, the Sind Peishin Railway, and the Kojak Pass, on which there was a tunnel 2½ miles in length through the Amram range. The ruling gradient on many of these frontier lines was 1 in 50, with curves of 800 ft. or 1,000 radius; but the Bolan Pass Railway had a ruling gradient of 1 in 25.

HARBOURS.

India was singularly deficient in harbour accommodation. On the whole of its coast between Calcutta and Bombay there was not a single port in which large vessels could lie alongside a wharf, so as to load and unload without the intervention of barges or lighters; and, during the monsoon, the landing of goods was a costly and dangerous undertaking. On the East coast the deltaic formation at the mouths of the great rivers caused shoal-water for a considerable distance from the shore; and vessels, even of a moderate size, had sometimes to lie several miles away from the port. Until the East Coast Railway was made this portion of India was practically closed for trade during the monsoon. The great Madras breakwater was little better than a white elephant. At Vizagapatam, on the East Coast, there were, however, great facilities for the formation of harbour and docks.

In Ceylon the construction of the breakwater had greatly increased the importance of Colombo as a port of call and a coaling station; but there were no docks or facilities for the direct handling of goods. There was a magnificent naturally landlocked harbour at Trincomali, but it was only used as a naval base and coaling station.

The harbour was perfectly calm in all winds, and there was deep water close alongside. By a small expenditure on wharves great facilities could be obtained for the direct handling of freight, while the space available for future extension was unlimited. It was surprising that this magnificent harbour was neglected.

INDIA'S ENGINEERING POTENTIALITIES.

In conclusion, the President said that the development of the latest wealth and industrial resources of India fell far short of its magnificent potentialities. What would the next half century bring forth? With regard to the demand for iron and steel, the London and North-Western Railway, with its few hundred miles of line, was able to manufacture its own steel rails, chairs, and other permanent-way materials, as well as its bridges, locomotives, and rolling-stock. Surely India, with its 27,000 miles of railways, ought to afford a demand sufficient to justify the manufacture of some of these in the country. Much remained to be done—in opening-up the country—in the prevention of famines—in the regulation of the water-supply—in the installation of works and factories—in the transmission of power generated by the hill falls to those centres where it could be profitably utilised, and in the general development of the resources of the Empire. The prosperity of India must in the next half century, as in the past, depend upon public works, initiated and carried out, in the future, mainly by members of this Institution of Civil Engineers, whose mission it was, in the words of their charter, to direct the great sources of power in Nature to the use and convenience of Man.

STAFFORDSHIRE IRON AND STEEL INSTITUTE.

ELECTRIC SMELTING OF IRON AND STEEL.

A meeting of this Institute was held on Saturday last, when Mr. J. H. Stansbie, B.Sc., read a paper on "Electric Smelting of Iron and Steel," and gave a series of practical demonstrations.

Electrical furnaces naturally fall into three types: (1) electric arc; (2) electric resistance; (3) electric induction.

The Stassano furnace is the best illustration of arc-furnaces to the smelting of iron and steel, and a careful study of its evolution from the crude furnace used by M. Stassano in 1899 to its present form should prove useful to those with a leaning towards the arc-smelting of iron ores. The original furnace resembled a small blast furnace in form and working; the latest form resembles a reverberatory furnace with a revolving bed, and is now being worked under the auspices of the Italian Government, at Turin, although M. Stassano did most of his work at Rome and Darfo.

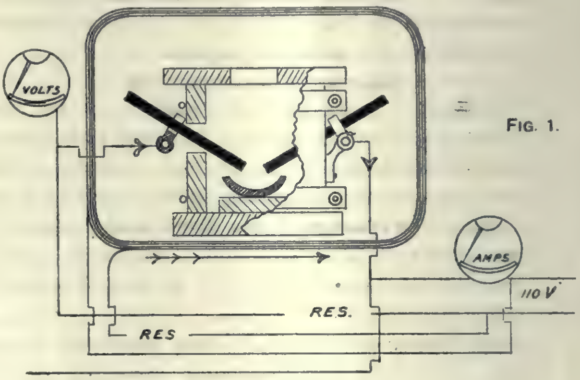
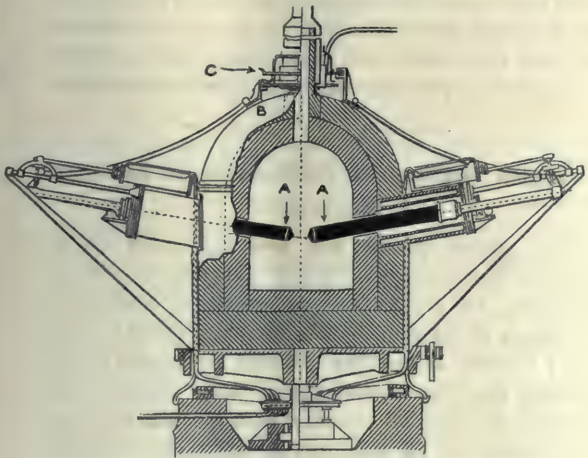


FIG. 1.

ARC FURNACE.

The furnace, which is illustrated in fig. 2, is circular in cross section, and the reduction chamber, which is 39 in. in diameter and 39 in. high, has a dome roof. It is lined with suitable refractory material, and the carbon electrodes, about 9 in. in diameter, enter the chamber through openings about midway between the floor and the roof. The electrodes are fitted with regulating gear by which they can be caused to meet in the centre of the chamber, or their ends may be brought flush with the walls. There are tap-holes for the metal and slag, and the parts of the electrodes outside the chamber are water-jacketed. The hearth is rotated on an axis slightly inclined to the vertical. The electrodes rotate with the chamber and proper contact with the power leads is kept up by an arrangement of brushes connected with the axis over the top of the chamber.



THE STASSANO FURNACE, latest form (longitudinal section.)
FIG. 2.

The electric resistance furnace has been developed to a remarkable extent by M. Keller. The complete apparatus may be described either as a double furnace or as a shaft-furnace with a separate hearth. This furnace is illustrated in fig. 3.

With regard to the cost of working, the last figures given by M. Keller are 1,200 h.p. passing into the furnace giving 2,800 k.w. hours per ton of metals. Total cost, per ton, 72-80 shillings. Further, he says that with 10,000 h.p. on the shaft of the turbine he could produce 60 tons of steel per day. For this he would place two fining furnaces in front of a reducing furnace; or tap the reduced metal from a number of furnaces into one large finery.

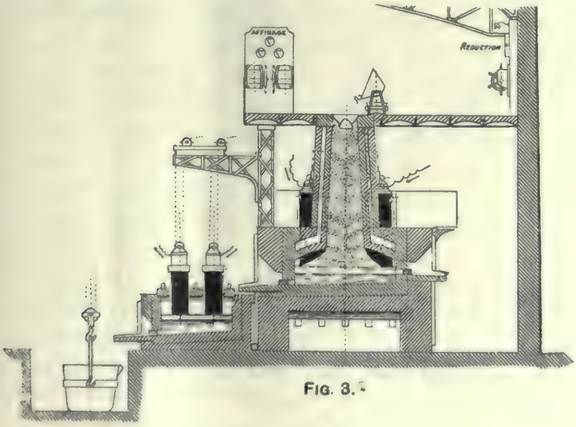


FIG. 3.

KELLER FURNACE.

M. Keller has recently patented another furnace, which he describes as a plurality of hearths communicating with a central crucible placed at a lower level.

The Heroult refining process is, perhaps, the best and most successful application of electricity to the metallurgy of iron. The furnace illustrated in fig. 4 resembles a small tilting-hearth; it has two massive carbon electrodes passing through the top, and connected with the power-leads. The process is intended for the conversion of cast iron and best scrap into best quality tool steel.

Electric induction furnaces, though novel in construction, present nothing new in principle.

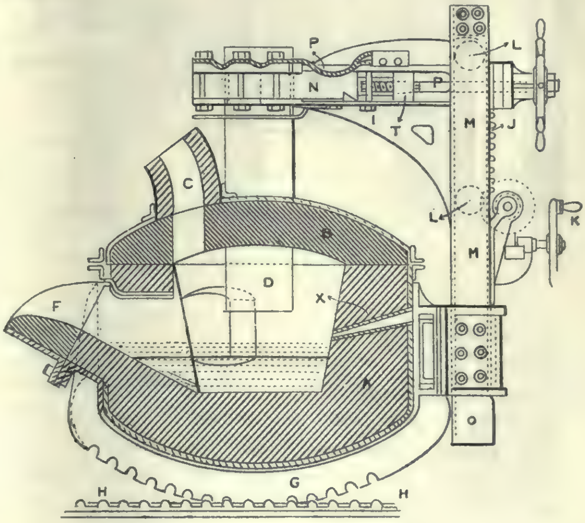


FIG. 4.

HEROULT FURNACE.

The Kjellin furnace, shown in fig. 5 is the most successful of this type. It is doing good work at Gysinge Bruk, in Sweden, and has been in operation there since 1900.

The furnace is circular in section, and the hearth consists of an annular space in the masonry, lined with either acid or basic material, and fitted with a cover and a tap-hole. In the centre is placed a massive iron core made of a number of thin soft iron plates.

This core is surrounded by a coil of insulated wire of many turns to form the primary circuit. The metal to be melted and refined is put in the annular hearth and forms the secondary circuit of the transformer. Alternating currents of 80 to 90 amperes, at a pressure of 3,000 volts, pass through the primary coil, effect rapid magnetic changes in the iron core, and set up a series of induced currents of 30,000 amperes at 7 volts in the ring of metal in the hearth. The resistance of this metal to these powerful currents raises its temperature above the melting point, and refining can be effected. The charge consists of good charcoal iron and scrap. No furnace gases come into contact with the metal, and a product of high purity is obtained. Iron alloys can be added to produce special steels.

It would appear from a consideration of these processes that the electric furnace will be entirely outclassed by the blast furnace as long as cheap coke can be obtained; but that the crucible steel making industry will be considerably influenced in the near future by electric smelting methods. Still the electric smelting of iron ores will probably be successful. The author in conclusion claims that it is in the preparation of iron alloys that the electric furnace has scored up to the present, and will probably score its most important successes in the future.

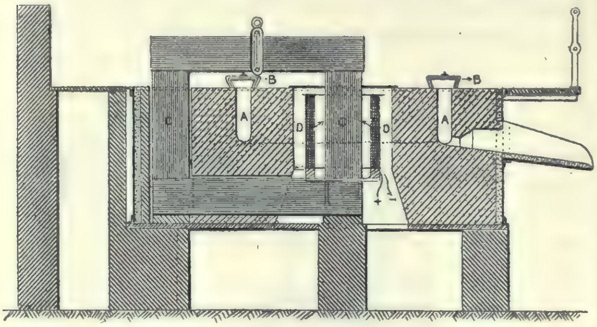


FIG. 5

KJELLIN FURNACE.

EXPERIMENTS.

The experiments included the preparation of Ferro Chrome, Ferro Silicon, Blister steel, and the reduction of cast iron from ore. During some of the experiments the operations inside the furnace were made visible by an arrangement of lenses and a prism throwing a view upon a large sheet.

In the discussion which followed, Professor Turner referred to the large electric smelting works at Niagara. He also drew attention to the very high percentage of Silicon in some of the Ferro Silicons now obtainable, and said that he had no difficulty in keeping pieces of 98 per cent. Ferro Silicon in good condition by excluding damp from the boxes in which they were placed, but that specimens containing from 25 per cent. to 35 per cent. readily disintegrated on exposure to air.

Other speakers referred to the great importance of the subject brought before them, and to the probable future of the electric smelting industry.

In acknowledging a vote of thanks, Mr. Stansbie said that in order to obtain 98 per cent. Ferro Silicon, it had been found necessary to arrange the furnace so that the Silicon was taken away from the point of highest temperature before the carbide was formed.

Glasgow Section of Institution of Electrical Engineers.

The annual dinner was held on Friday last, at the New Banqueting Hall of the Grosvenor Restaurant, Glasgow. The gathering was thoroughly representative, the heads of the municipality being represented by the Lord Provost of the City and the convenors of the various electrical committees of both Glasgow and Edinburgh, while the electrical industry was also well represented by the President of the Institution, Mr. Robert Kaye Gray, with practically all the Corporation Engineers of Scotland, and representatives from all the big manufacturing concerns.

The chair was taken by Mr. Robert Robertson, who is this year's President of the section. Covers were laid for about 200 gentlemen. After the usual loyal toasts had been duly honoured, Professor Archibald Barr gave "The Imperial Forces," Engineer-Commander W. Onyon, R.N., and Surgeon-Captain W. D. Macfarlane, jun., responding. The former, in speaking of the Navy, referred to the almost universal adoption of electricity for all the auxiliary work on present battleships and cruisers, and stated that in the new ones electricity would play a still more important part.

Sir David Richmond proposed the toast of "The Lord Provost and the Corporation of Glasgow." The Corporation, he said, was a very mixed body, but it contained men of large experience of public affairs and business, and that knowledge served them well when occasion required. But these were not the men who did the talking. Having touched on the duties and the powers of the Town Council, he referred to the apathy of many electors in regard to municipal affairs, and advised them to send men of experience, men of knowledge, and men accustomed to grasping great affairs, to the Town Council; then, and only then, would the work of the Corporation be carried through.

The Lord Provost, in reply, said he could not perhaps agree with all the strictures of Sir David Richmond, but he would at least agree with him in this, that it would be an evil day for Glasgow when her destinies were confided to the doctrinaire and to the evange of an extravagant gospel, who sought the platform of the Town Council as a fitting ground to promulgate his fads and visionary dreams. He did not dispute the value of the reactionary coming in from time to time. The reactionary frequently put his finger on defects in the body politic, and if he too often painted with a lurid brush, probably the luridness of his painting awakened an interest and a desire for correction which, in the main, were helpful. He also referred to the great work that electricity did in connection with the municipality of Glasgow, and to the splendid tramway car-service, which, he claimed was second to none in the kingdom. He hoped that electricity would, in the time to come, tackle one other civic problem that he considered of great importance for the welfare of the City of Glasgow, viz., the smoke problem, and he foresaw the time when this would be adequately dealt with by electricity.

Mr. R. D. Monro submitted the toast of the "Institution of Electrical Engineers." Mr. Robert Kaye Gray, President of the Institute of Electrical Engineers, in reply, said he had just returned from America, and after visiting Boston, New York, Chicago, St. Louis and Pittsburg, he thought Glasgow had the finest electric tramway system in the world. The only objection he had to it was the aerial wires. The Americans claimed to be very much ahead of us, but he doubted it. The membership of the Institution, he added, was now 5,460.

Mr. G. C. Lloyd, Secretary of the Institution, gave the "Glasgow Local Section," the Chairman replying.

LEEDS ASSOCIATION OF ENGINEERS.

A meeting of the Leeds Association of Engineers, was held on October 27th. The president (Mr. G. R. Goldsack) occupied the chair.

A paper by Mr. J. C. Jefferson on "Recent Improvements in Water-Tube Boilers," was read in his absence by Mr. J. C. Moorhouse. It was a satisfaction, said the author, to state that in his opinion the most important of these improvements had emanated from Leeds, and from a member of the Association. The water-tube boiler had vastly increased the amount of power available over the flame-tube boiler, but unlike the latter had required fifty years for its growth. The late improvements had resulted in a compound of the Scotch locomotive and water-tube boilers. He did not know of any other design of boiler for any purpose which so completely fulfilled the requirements. It would be remembered that the report of the Committee on the suitability of water-tube boilers for the Navy indicated that some compromise between the Scotch and water-tube boilers was desirable.

Small models of the various systems described, also sections of the joints and tubes were placed on the table for inspection, together with a small model having a few of the double flow water tubes fitted into a tank to demonstrate the rapid and systematic circulation produced.

Mr. Alfred Towler said that although the water-tube boiler had not been altogether a success and had been condemned by the Commission, the boiler described impressed one favourably, especially for marine purposes, and it was pleasing to anticipated that a new industry might be opened out in Leeds.

An interesting debate was contributed to by several other speakers.

THE JUNIOR INSTITUTION OF ENGINEERS.

The members of this Institution paid a visit recently to Messrs. Stuart's Granolithic Stone Works at Millwall Dock, Mr. Peter Stuart showing them over. He had considerately kept the machinery running, so that all the processes in the manufacture of the stone could be seen. Electric power is used for the crushers and grinders, current being obtained from the public supply. There is also an electric elevated transporter running on a rail for conveying finished blocks between different parts of the works. Some striking examples of the strength of the material were shown and tests were conducted on some of the specimens. Before the party dispersed Mr. Adam Hunter, Vice-Chairman of the Institution, expressed their acknowledgments for the kind reception which had been accorded.

Last Saturday afternoon, through the kindness of Dr. R. T. Glazebrook, F.R.S., Vice-President, an inspection was made of the National Physical Laboratory, at Bushey House, Teddington, of which he is the director. For upwards of two hours the members under his guidance, with that of the staff, were kept interested examining and listening to the explanations of the uses and modes of manipulation of the many instruments and appliances to be seen throughout the various departments of the Laboratory, including thermometric, electrical, photometric, metallographic metrologic, photographic, optical, chemical and engineering (wind-pressure testing, alternative stress testing, insulating material testing, temperature distribution in field coils, etc.). Mr. S. Cutler, junior. moved a vote of thanks to the director and his staff at the conclusion of the visit.

TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION.

At the meeting of this Association at the Society of Arts last night, Mr. A. N. Connett, M.I.C.E., submitted a paper entitled "Notes on a permanent way for tramways." The author said that while the subject was somewhat hackneyed, it was by no means exhausted.

The result of the efforts of the Standardising Committee had made improbable for a long time to come, changes in the sections of tramway rails of the ordinary girder type; still, this did not mean that finality has been reached in the design of tram rails. Many types of rails had been designed and a number actually made and used. but none of these had proved superior to the ordinary well-designed girder tram rail.

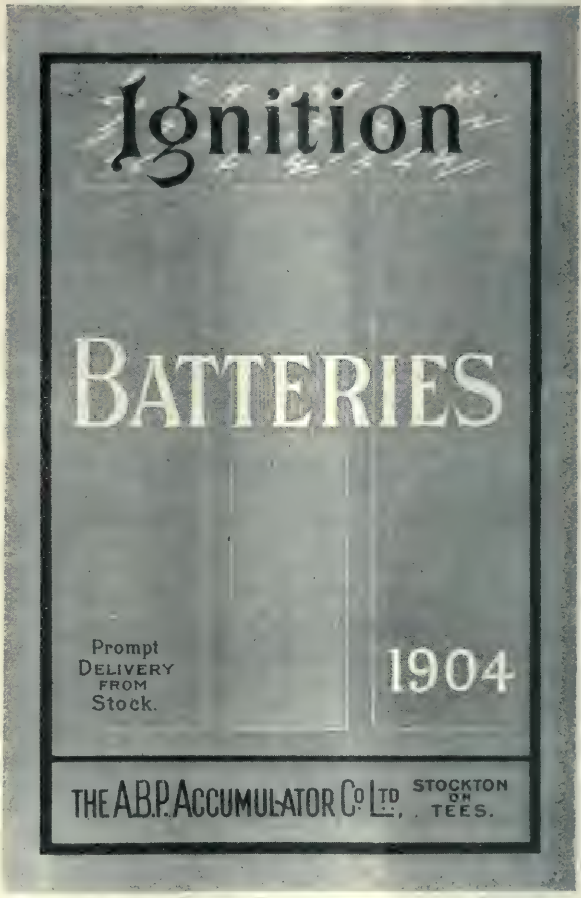
The question of joints was a difficult one, the life of the rail being limited by the wear at the joints, Splice bars of special form, or ordinary bars in conjunction with some other device, formed the great majority of joints, patented or otherwise. While there was no necessity for a tramway engineer to give much consideration to the possible bad effect of unduly stiffening the joint on account of prejudicially affecting the continuity of the "wave," it should be borne in mind thaton the other hand the tramway engineer had a serious condition to meet that the railway engineer had not, in that the tram-joint is inaccessible for inspection and repairs. This in reality was the vital difference.

With regard to the wearing of rails at curves, his view was that with the standard type of curve rails much better results would be obtained. Perhaps in the near future curved rails would be rolled of more suitable material, say nickel steel.

On the subject of construction the author had little doubt that the concrete type of construction would remain standard in this country, but he would call attention to an interesting variation adopted at Hull. The construction in that case was essentially concrete, but there was interposed between the rail and the concrete a creosoted Baltic redwood sleeper 4 in. deep and 7 in. wide. The purpose of the wood-liner was to give some elasticity to the running rail. The cost of ordinary maintenance at Hull is only about a quarter of that found on other tram lines which have been in operation for the same period. The author also directed attention to the marked tendency in permanent-way construction to firmly anchor the rails to the concrete bed.

CATALOGUE COVER DESIGN.

THE effective design chosen for the latest catalogue of the A.B.P. Accumulator Company, Ltd., of Stockton-on-Tees, is rendered in a pleasing shade of pale blue, the electric flashes, and the word "Batteries," together with the year, being thrown into strong relief in white. The treatment is simple, but appropriate and owing to its uncommon appearance, the cover is likely to attract attention to the inside. Although only a small pamphlet, this production is a good illustration of what the artist can do to render attractive an ordinary prosaic price list



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THE ENGINEER'S BOOK OF THE WEEK.

"ELECTRIC MOTORS."

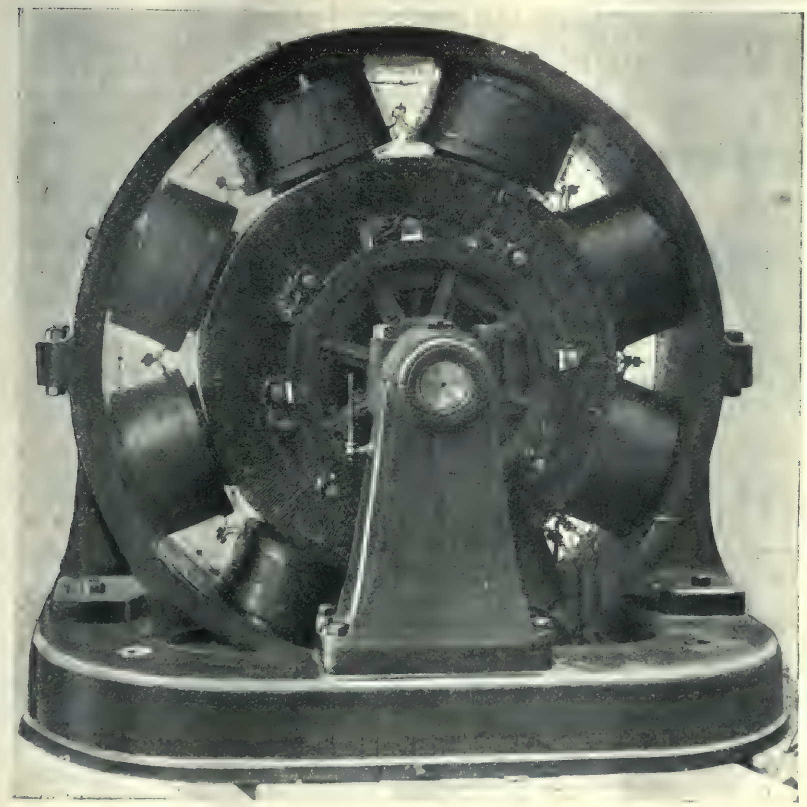
THE author has succeeded in producing a book, which teaches much and suggests more than it teaches. It would be impossible in a brief notice to do more than indicate the general scope of the author's intention, and the reader who desires to know more about the latest developments on the subject may be safely counselled to get the book for himself. To give a running index of its contents is all that is now attempted.

The relative merits of continuous current motors and alternating current motors are discussed at the outset. They have been in competition now for some ten years and the weight of expert opinion still inclines to the view that the continuous current motor will not only maintain its present position in England, but that on the Continent and in America there will be a tendency towards its increasing use in mills mines, factories and shipyards, even although the electric energy at its source is produced in the form of alternating currents. The two chief classes of continuous current motors are familiar as shunt motors and series motors, the former being used for constant speed stationary motors, and the latter for tramways and for work where wide ranges of torque are required. Some data for motor designing is given in a succeeding chapter, and types of winding are discussed at some length. A great deal of space is naturally taken up with the subject of motor designing and testing, and the methods of obtaining variable speed with continuous current motion is discussed, and some valuable statistical matter given in this connection.

In dealing with alternating current motors in Part II., it is easy to see that the author does not altogether agree with the opinion quoted earlier, that this type of motor has been overrated, and he opines that from the present outlook there will be many extensive areas where alternating current motors alone will be available. Attention is specially directed to the desirability of using polyphase currents. An interesting chapter is that on "Methods of starting induction motors," and a comparison is made of English and American types in motors of this class. A good deal of space is necessarily devoted to the design of induction motors, with numerous quoted examples.

The appendix, giving a table of the properties of copper wires for the principal gauges in use in different countries, should prove useful. The illustration shows a 400-h.p. rolling mill motor, referred to on page 147 of the book. The work is copiously illustrated.

"Electric Motors, Continuous Current Motors, and Induction Motors. Their Theory and Construction," By Henry M. Hobart. Whittaker and Company.



From Electric Motors.

400 H.P. ROLLING MILL MOTOR.
By A. V. Clayton, Ludvika, Sweden.

TABLE I.—CONSUMPTION-TEST OF TURBO-GENERATOR, NO. 948, ON MARCH 18TH, 1904.

Time of Observations.			Duration for 370 Pounds of Coal.		Water Consumed per Hour.		Pressure per Square Inch at Stop-valve.	Cylinder-vacuum in Mercury-column.	Speed per Minute.	Average Power.	Readings on Main Armature.		Readings on Main Armature-field	
					Total.	Kilowatt.								
Hours.	Mins.	Secs.	Minutes.	Seconds.	Pounds.	Pounds.	Pounds.	Inches.		Kilowatts.	Volts.	Amperes.	Volts.	Amperes.
							A.—FULL LOAD.							
10	32	33	Start.											
10	37	0	4	27	4,989	25·00	100	27·9	3,400	199·8	550	358	550	3·93
10	41	30	4	30	4,933	24·52	101	27·9	3,400	201·2	550	360	550	3·93
10	46	4	4	34	4,862	24·20	100	27·9	3,400	201·36	549	360	549	3·93
10	50	35	4	31	4,916	24·72	97	27·8	3,400	198·8	548	358	545	3·93
10	55	7	4	32	4,898	24·31	100	27·85	3,400	201·44	547	372	547	3·93
10	50	25	4	18	5,163	24·90	102	27·85	3,400	207·84	545	371	545	3·93
11	3	42	4	24	5,045	24·40	103	27·85	3,400	206·3	544	360	544	3·93
11	8	21	4	32	4,898	24·20	100	27·85	3,400	202·2	545	369	545	3·93
11	12	47	4	26	5,008	24·40	100	27·85	3,400	205·8	545	369	545	3·93
0	40	14*	for 3,330 pounds.		4,968	24·5	100	27·86	3,400	202·75	547	364	547	3·93
							B.—HALF LOAD.							
11	50	42	Start.											
11	58	15	7	33	2,939	28·5	102	28·0	3,400	103·2	535	202	534	3·78
12	5	44	7	29	2,966	29·2	102	27·95	3,400	101·86	533	200	533	3·78
12	13	21	7	37	2,914	28·65	103	27·95	3,400	101·7	532	202	532	3·78
12	20	51	7	30	2,960	29·01	102	28·0	3,400	102·0	533	202	533	3·78
12	28	13	7	22	3,013	29·3	102	28·05	3,400	102·82	531	201	531	3·78
12	35	52	7	39	2,901	28·6	100	28·0	3,400	101·93	530	201	530	3·78
12	43	18	7	26	2,986	29·4	101	28·0	3,400	101·76	530	202	530	3·78
12	50	40	7	22	3,013	29·5	100	28·0	3,400	102·0	530	202	530	3·78
0	59	58*	for 2,960 pounds.		2,961	29·02	101	27·99	3,400	102·16	532	201·5	532	3·78

* Duration of test.

NOTES.—Barometer, 29·75 inches. The rise in speed from full load to no load was 2½ per cent. The temperatures after a run of 3 hours at full load, of 2½ hours at half load, and of over quarter-load, were as follows:—

	Temperature. Degree Fahr.	Rise of Temperature. Degree Fahr.
Atmosphere	80	—
Armature	142	62
Commutator	119	39
Shunt field coils	143	63
Series field-coils	108	28
Compensating field-coils	135	53

New Electric Power Plant at Houldsworth Colliery.

ON the occasion of a visit by the Mining Institute of Scotland to the Houldsworth Colliery of the Dalmellington Iron Company, Ltd., about ten miles south-east of the county town of Ayr, an opportunity was afforded of viewing the new electric power plant. The colliery is connected by two miles of private railway to the Company's iron works, where the output is used in the making of pig-iron.

Mr. William Smith, in the course of a description furnished to members, says: The electric power plant just started consists of a Parson's steam turbine coupled direct to a continuous current dynamo, and gives an output of 200 kilowatts at 500 volts and 3,500 revolutions per minute.

As this is the first plant erected for colliery work in Scotland a few details of the plant may be mentioned. The machine is of the latest improved parallel compound type, adapted for the full range of expansion from the initial to the condenser pressure. It is designed for a working steam pressure of 100 lb. per square inch. The lubricant is forced under pressure to all the bearings. by a pump working from the turbine shaft, all bearings being connected together and to the oil reservoir by means of pipes 3 in. in diameter. The governor, of the mechanical centrifugal type connected to intermittent mechanism, is arranged to maintain a constant speed. It is fitted with hand regulating gear so that the speed may be adjusted 10 per cent. up or down, while the machine is running. The ejector-condenser, used to give the vacuum, was adopted because for a number of months in the year a sufficient quantity of surface water can be collected at the necessary height.

The dynamo is compound wound and of ample size to allow of running over long periods without undue heating.

The electric current is conveyed to the pit bottom with cables of 61/084 area, vulcanised and armoured with two layers of galvanised wire. They are supported in the shaft with pitch pine cleats, 6 ft. long by 12 in. wide, fixed to the buntons, at intervals of 120 ft.

No trials of the efficiency of this plant have been made, but the tests recorded in Table I. (see page 562) were carried out in the presence of the company's engineer at Messrs. C. A. Parson and Co.'s works, Newcastle-on-Tyne.

At present the current from the turbine is taken to a Reidler pump at the shaft bottom and to a three-throw pump in the south dock; this takes up less than half the power available, and that in reserve will be used to duplicate the shaft pump or for haulage purposes if required.

The Reidler pump raises 150 gallons per minute against a head of 1,280 ft. The shaft is 1,250 ft. deep, but 30 ft. is added to the head when the water is forced to the pond supplying the condenser, which is necessary when the supply of surface water is inadequate. The pump plunger is $3\frac{13}{16}$ in. in diameter with a stroke of 15 in., and runs at a speed of 120 revolutions per minute. It is driven by six cotton ropes, $1\frac{3}{8}$ in. in diameter, a Westinghouse shunt wound motor of 90 b.h.p., running at 500 revolutions per minute. The ratio of the drive is 4 to 1. It has also a charger for the air vessels, by-pass valves, and a spring relief valve set to open at a pressure slighty in excess of the statical pressure of the column. The discharge column consists of steel pipes, 9 in. in diameter and $\frac{3}{8}$ in. thick, screwed and fitted with cast steel flanges. This column was made of sufficient size to allow of the pump being duplicated.

The three throw pump is of the Campbell all-bolt type, with plungers $4\frac{1}{2}$ in. in diameter and 9 in. stroke to deliver 50 gallons per minute against a head of 600 ft. It is driven by belt from a motor of 15 b.h.p.

The following table from the same paper gives an interesting comparison between machine drilling and hand labour in driving a gallery through green whinstone. This whin became very hard and in some parts was filled with ironstone-balls. It was quite common for a miner's shift of eight hours to be wholly occupied in boring, by hand, a hole $1\frac{1}{4}$ in. in diameter and 2 ft. deep. A small compressed air plant was erected capable of driving two rock-drilling machines, which were put to work, and Table II. shows the difference of cost of the portion driven by hand and of that driven by the machine-drills:—

TABLE II.—COST OF DRIVING A GALLERY IN GREEN WHINSTONE.

Method of Drilling.	Length of Gallery Driven. Feet.	Time of Driving. Weeks.	Average Length of Gallery driven per Week. Feet.	Cost of Gallery per Fathom. £	s.	d.
Hand ...	180	23	7·8	10	18	5·3
Machine ...	192	14	13·7	9	0	9·6

By using machine-drills, there was a gain per week in cutting of 75 per cent., and at a less cost of £1 17s. 7·7d. per fathom.

NEW PUBLICATIONS.

"THE DISEASES OF ELECTRICAL MACHINERY."

By Ernst Shulz; edited with a preface by Silvanus P. Thompson. E. and F. N. Spon. 2s. net.

The increasing use of electricity as a motive power renders the study of the diseases of electrical machines one of primary importance. In this little volume which has the advantage of Dr. Silvanus P. Thompson's editorship, explanations are given of those defects and shortcomings which occur in the operation of electrical machines, and, to a certain extent, the faults of manufacture, and errors in calculation and design. The writer's elucidations are not restricted to machines, but include also such pieces of auxiliary apparatus as regulating rheostats and starters. The suggested remedies are accompanied with numerous diagrams.

"MECHANICS."

By John Cox, M.A., F.R.C.S. Cambridge Physical Series, edited by F. H. Neville, M.A., F.R.S., and W. C. D. Whetham, M.A., F.R.S. Cambridge University Press. 9s.

The author of this new treatise on Mechanics modestly states that it is but "a poor and incomplete abridgment" of Professor Ernst Mach's "Mechanik." To a certain extent an acknowledgement of this description disarms criticism, but we have no great fault to find with the compiler, although we wish better attention had been bestowed upon the reproductions of the photographs of experimental apparatus. The present translation contains the embodiment of the system of teaching mechanics at which the author has arrived after thirty years' practical experience. His aim has been to produce a text-book of mechanical principles, avoiding as far as possible merely mathematical difficulties, and to develop the principles in their historical order, shewing how the foremost investigators attacked those problems. The work is divided into four sections—the winning of the principles; mathematical statement of the principles; application to various problems; the elements of rigid dynamics.

BOOKS RECEIVED.

The Automobile Industry. By Geoffrey de Holden-Stone. With numerous diagrams and illustrations. Methuen and Co. 2s. 6d. net.

Mechanics Applied to Engineering. By John Goodman, M.Inst.C.E. With 714 illustrations and numerous examples. Fourth edition. Longmans and Co. 9s. net.

Steam and Steam Engines, including Turbines and Boilers. By Andrew Jamieson, M.Inst.C.E. With diagrams, folding plates, and examination questions. Fourteenth edition. Revised. Griffin and Co. 10s. 6d.

Work. The Illustrated Weekly Journal of Handicrafts. Vol. xxvii. Cassell and Co.

Smoke Prevention and Fuel Economy. (Based on the German Work of E. Schmatolla.) By Wm. H. Booth, M.Amer.S.C.E., and John B. C. Kershaw, F.I.C. With seventy-five illustrations. Constable and Co. 6s. net.

Metalworking. A Book of Tools, Materials, and Processes for the Handyman. Edited by Paul N. Hasluck. Cassell and Co.

Practical Coal-Mining. An elementary classbook. By T. H. Cockin. Lockwood and Son.

Mechanics, Manuals. Illustrated. Edited by Paul N. Hasluck. Cassell and Co. Building Stones; Road and Footpath Construction; 6d each, net.

Small Destructors for Institutional and Trade Waste. By W. Francis Goodrich. With twenty-eight illustrations. Constable and Co. 4s. net.

NEW CATALOGUES.

Ferranti, Ltd., Hollinwood, Lancashire.—Catalogue No. 9 describes and illustrates the firm's Alternating Reverse Current Time-Limit Relay for Automatic Switches; Catolague No. 10 is a price list of Moving Coil Instruments for continuous currents.

Holden and Brooke, Ltd., Sirius Works, West Gorton, Manchester. List No. 68 describes Brooke's "Positive Flow" Hot Water system of heating buildings. The leading advantage claimed for the system is that it provides a positive (*i.e.*, forced) circulation of hot water at a low pressure at an efficient and wholesome temperature, and at the same time places the amount of heat supplied to every radiator under absolute control without affecting the remainder of the system.

The Lahmeyer Electrical Company, Ltd., of 109-111, New Oxford Street, London, W.C.—From this firm we have received two preliminary price lists, one being for Continuous Current Motors up to 10 h.p. and the other for the firm's Schuler Patent Single-phase Alternating Current Motors.

The Cambridge Scientific Instrument Company, Ltd.—We have received a pamphlet from this firm on a subject which is now receiving a great deal of attention at the hands of progressive firms, *i.e.*, Technical Thermometry. It is really a new and revised edition of a small catalogue issued by the firm some time ago, entitled "The Measurement of Temperature by Electrical Means." It is essentially a catalogue which should be obtained and filed for reference.

The British Thomson-Houston Company, Ltd.—Pamphlets 173 and 174 are concerned, respectively, with field rheostats and motor starting rheostats. The punching of these pamphlets reminds us of the excellent system by which the various sections of this firm's catalogue can be bound up in one homogeneous volume as issued. Pamphlet No. 175 (illustrated) supersedes No. 155, issued October 16th, 1903, and is devoted to two and three-phase induction motors.

MEETINGS FOR THE ENSUING WEEK.

FRIDAY, Nov. 4.—Institution of Electrical Engineers: Manchester Students meet at the School of Technology.—Paper, "Electric Railways," by F. O. Mills, at 7.30.—Geologist's Association: Conversazione at the London University College.

SATURDAY, Nov. 5.—Birmingham Association of Mechanical Engineers Monthly Meeting at the Grand Hotel, Birmingham.

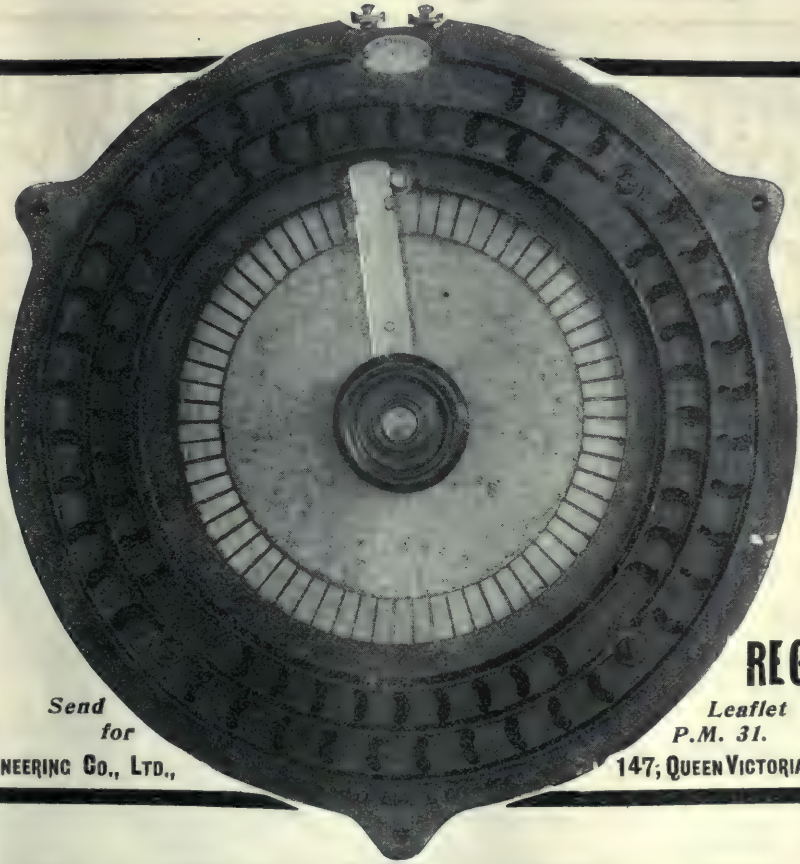
MONDAY, Nov. 7.—Society of Engineers meet at the Royal United Service Institute, Whitehall, 7.30 p.m.—General Meeting of the Royal Institution at 5 p.m.—Royal Geographical Society meet at the Queen's Hall to hear Lecture by Captain Robert Scott on his Antarctic Expedition.

TUESDAY, Nov. 8.—Royal Colonial Institute meet at the Whitehall Rooms, Hotel Metropole, 8 p.m.—Meeting of the Glasgow Local Section of the Institution of Electrical Engineers at the Institution of Engineers and Shipbuilders, Bath Street.

THURSDAY, Nov. 10.—Institution of Electrical Engineers. Presidential Address by Mr. Alexander Siemens, at Great George Street, Westminster, 8 p.m. Meeting of the Dublin Local Section at the Royal College of Science.

FRIDAY, Nov, 11,—Tramways and Light Railways Association visit the London County Council's Power Station and Car Sheds.—Electro-Harmonic Society: Concert in the King's Hall, Holborn Restaurant.

PAGE'S WEEKLY Miscellaneous



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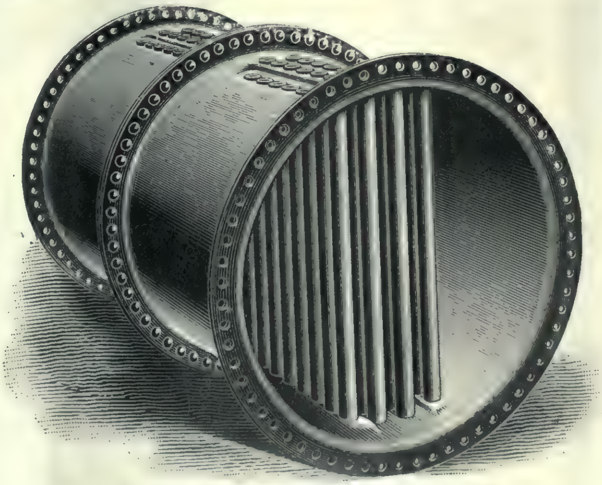
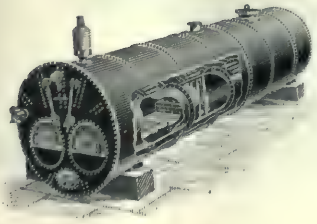


Part view of Flue fitted with PREMIER TUBES.



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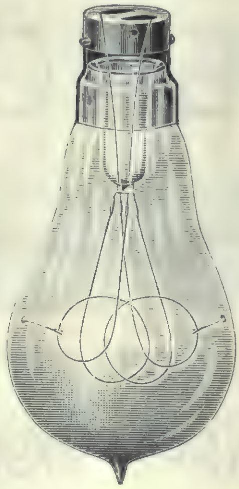

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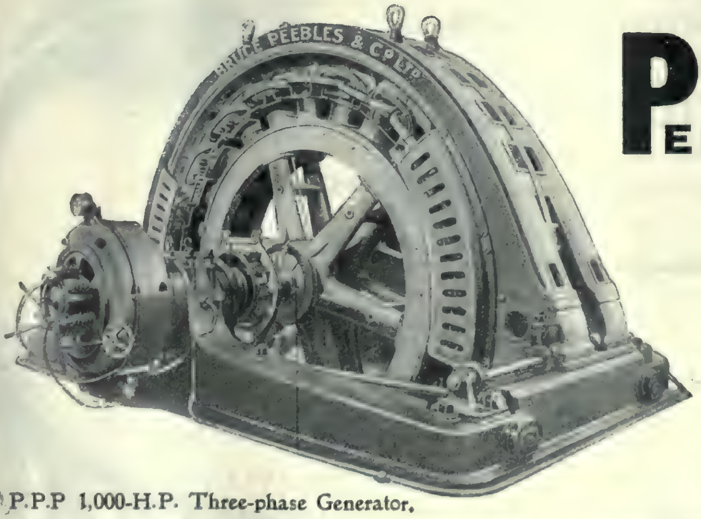

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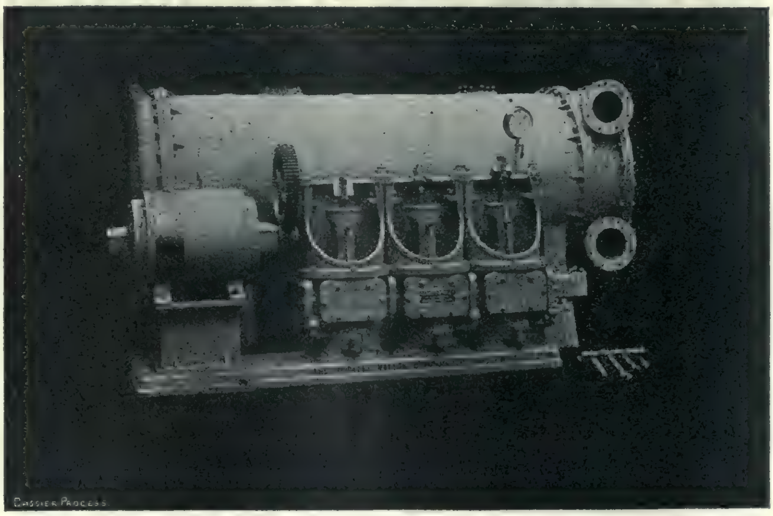

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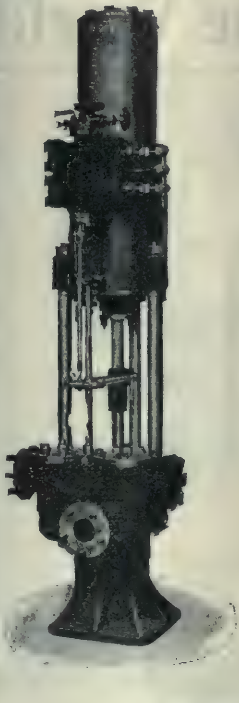

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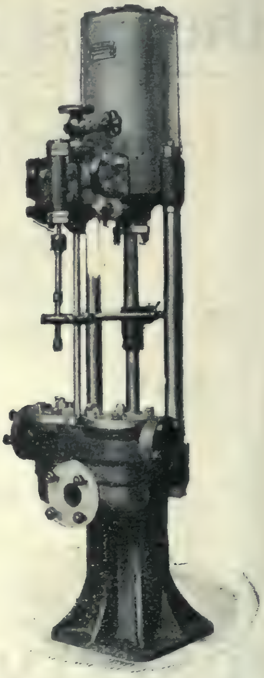

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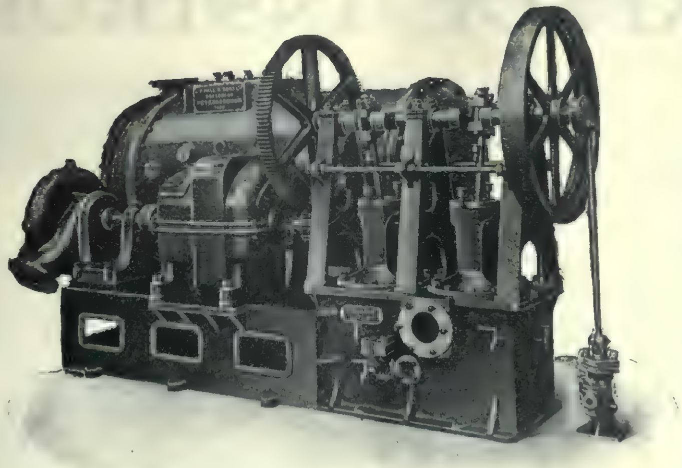

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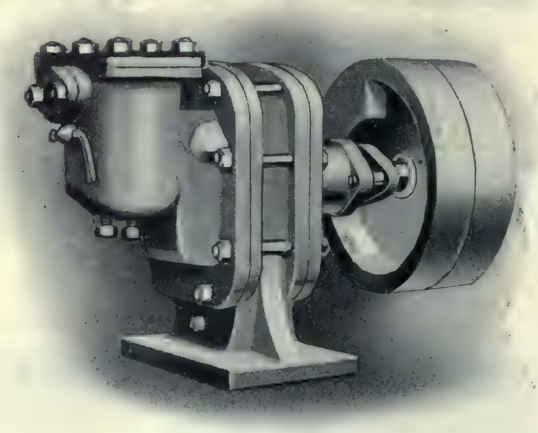

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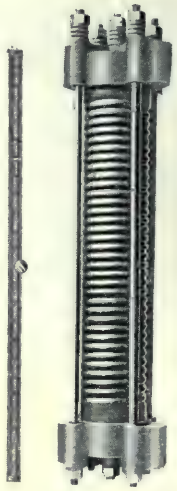

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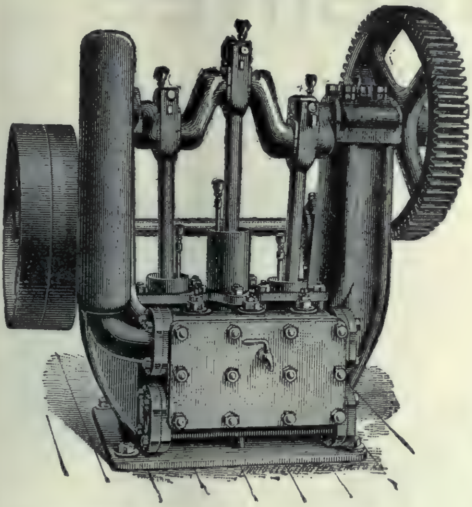

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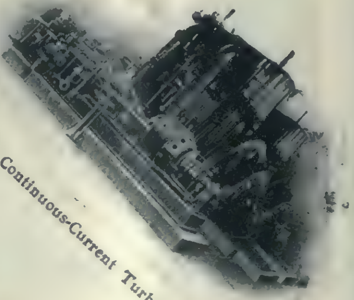

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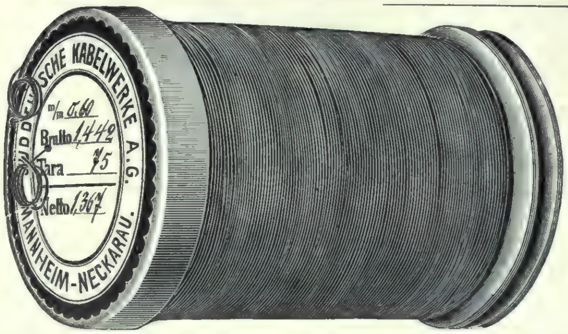

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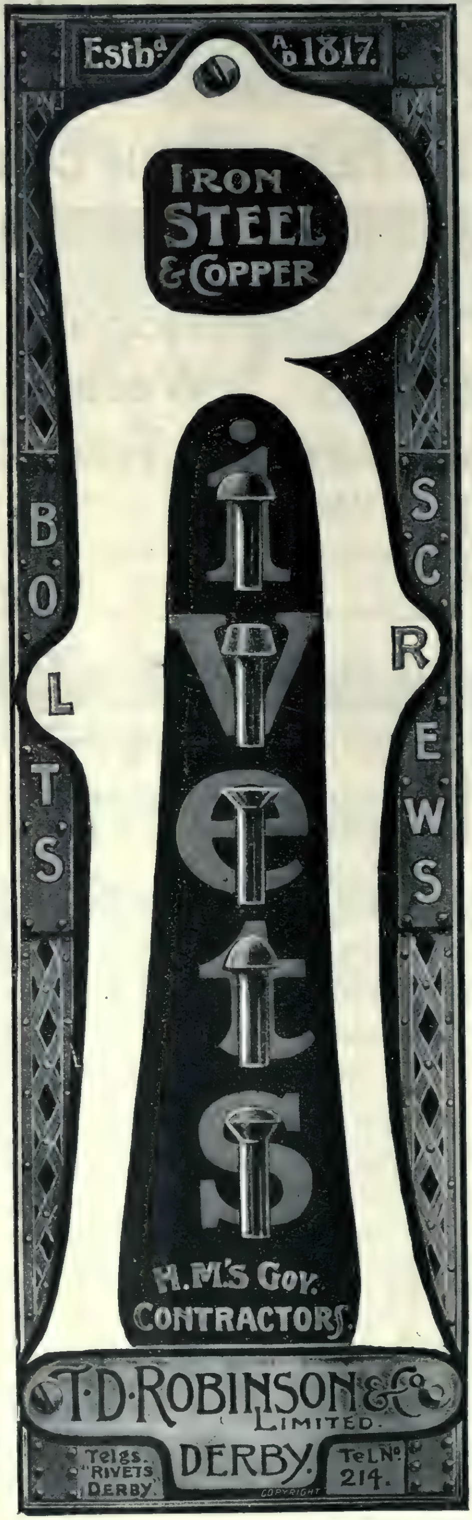

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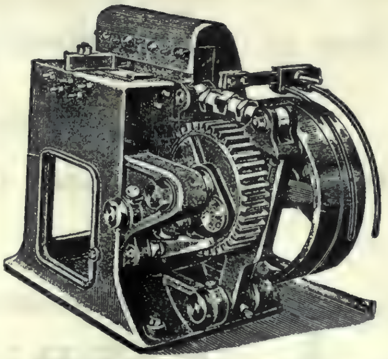

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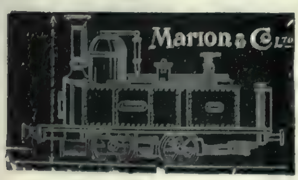

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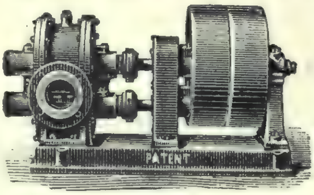

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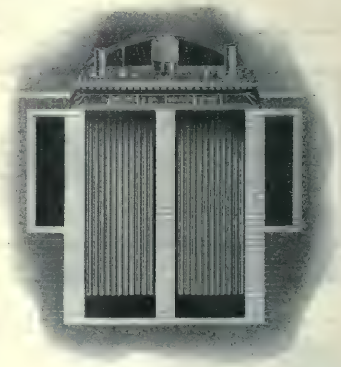

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Tues.	7		8	9		10		11		12		2		3		4		5		6		7		
Wed.	7		8	9		10		11		12		2		3		4		5		6		7		
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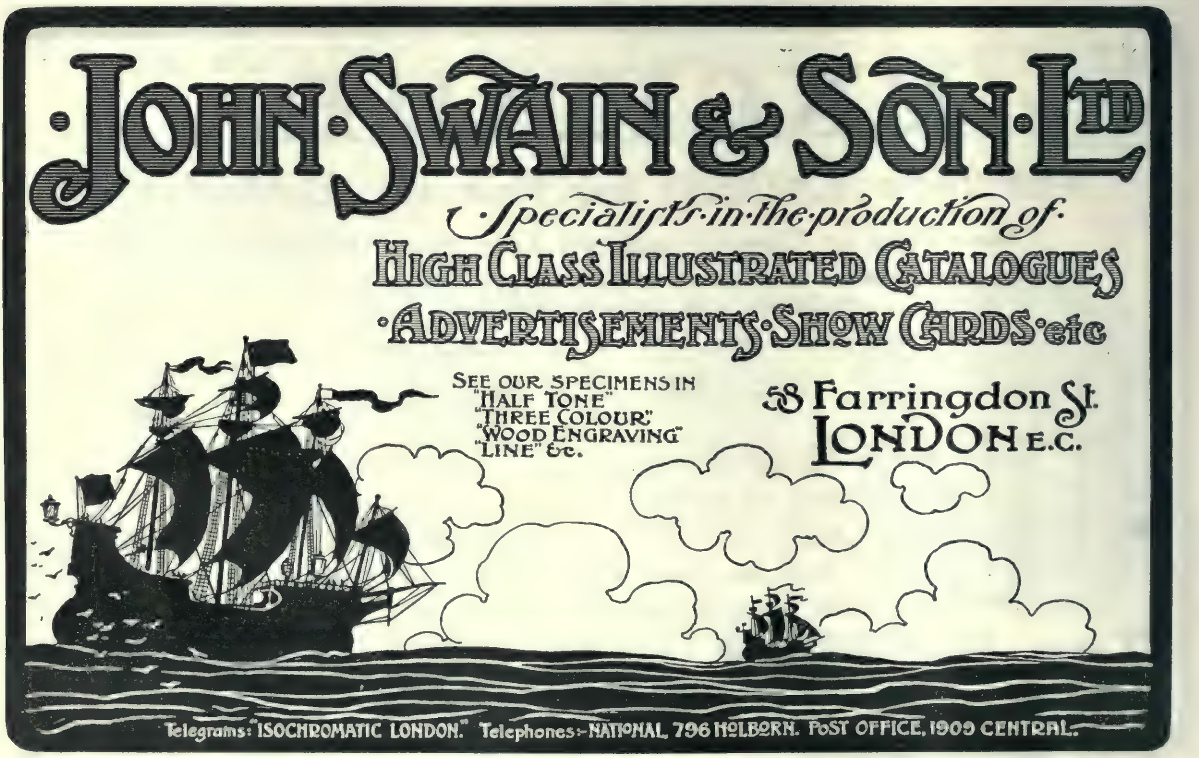

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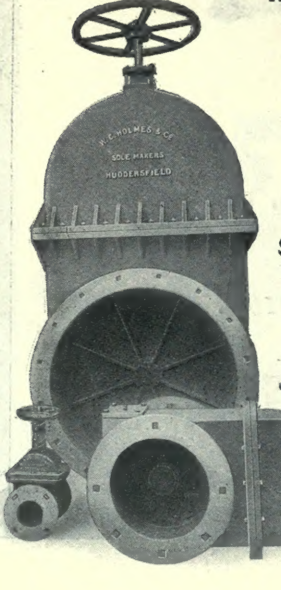

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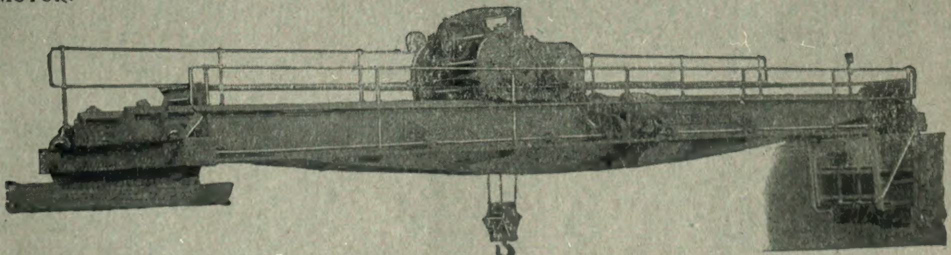

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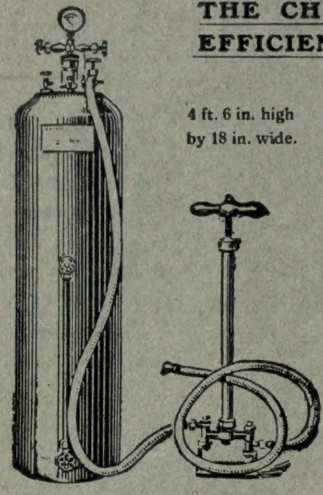

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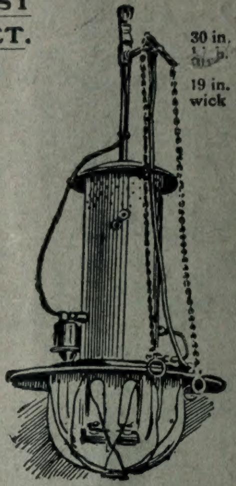

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